AGRICULTURAL DEVELOPMENT UNDER URBAN PRESSURE, COASTA RICA

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dedicated

to my parents

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ABBREVIATIONS

AID - Agency for International Development

AMV - Alan M. Voorhees and Associates

BCCR - Costa Rican Central Bank

CACM - Central American Common Market

CCSS - Costa Rican Social Security

CESPO - Center for Population Studies, CR

CLAS - Center for Latin American Studies, UF

CNP - National Production Council, CR

CR - Costa Rica

DGEC - Costa Rican Census Bureau

ERS - Economic Research Service, USDA

FAO - Food and Agricultural Organization, UN

FAS - Foreign Agricultural Service, USDA

GDP - Gross Domestic Product

IFAS - Institute of Food and Agricultural Sciences, UF

IGN - National Geographical Institute, CR

IICA - Inter-American Agricultural Sciences Institute, CR

INVU - National Housing and Urbanization Institute, CR

ITCO - Land and Colonization Institute, CR

LADB - Latin American Data Bank, UF

MAG - Ministry of Agriculture and Livestock, CR

MOPT - Ministry of Public Works and Transport, CR

MPC - marginal propensity to consume

MRC - multiple regression coefficient

N - coefficient of income elasticity

OFIPLAN - National Planning Office, CR

OPAM - Metropolitan Area Planning Office, INVU

PADCO - Planning and Development Collaborative

PEA - Economically Active Population

PNDU - National Urban Development Plan

SBN - National Banking System, CR

SJMA - San José Metropolitan Area

SNAA - National Water and Sewage Institute, CR

UCR - University of Costa Rica

UF - University of Florida

UN - United Nations

USDA - United States Department of Agriculture

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AGRICULTURAL DEVELOPMENT UNDER URBAN PRESSURE, COSTA RICA

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Urbanization and agricultural production compete for resources in areas with high rates of population and per capita income growth. An inquiry into the manner in which agricultural production has changed in Costa Rica and the San José Metropolitan Area was undertaken with emphasis on the period from 1950 to 1973. The objectives were to analyze historical land use, to measure the changes in urban and rural populations and areas, to calculate the growth in per capita income, agricultural production and consumption, and to determine and explain the effects of rapid urbanization on agricultural production. The major hypothesis was that farm land and labor productivity would increase with the addition and substitution of modern production inputs for traditional production factors as changes occurred in relative factor price ratios and as urbanization, per capita income and food prices increased. Results indicate the closure of the agricultural frontier as a means for expanding production. Increases in food prices, land values, and wages occurred as urban population and per capita incomes increased. Increases in the use of modern production inputs such as fertilizer, higher yielding varieties of crops and machinery were used to increase farm land and labor productivity. Changes occurred in the number and area in farms, land use, and institutional arrangements in the agricultural sector surrounding the nation's capital in response to the increased demand for land for urban uses. Theoretical economic explanations of urban frontier expansion and technological innovation in agriculture provide a framework for explaining these phenomena.

W. W. McPherson

Chairman

CHAPTER 1
INTRODUCTION

Nature and Scope of the Problem

This study focuses upon the effects of increases in per capita income and urban growth during the last quarter century on land use, land values and the productivity of agricultural land and labor inputs in the area surrounding the city of San José, Costa Rica. The purpose of this study is to ascertain the manner in which agricultural productivity has grown under conditions of increased demands of an expanding urban population for agricultural products and factors. The major hypothesis is that producers have increased yields by the addition of modern inputs to inelastic supplies of land and have substituted machinery capital for the declining share of agricultural workers in the total labor force. It is postulated that these innovative changes in agricultural production have been induced by a decline in the ratios of fertilizer and machinery prices relative to the price of land and wage rates, as urbanization and income growth have reduced land and labor available to the farm sector and as food prices have risen.

Less developed countries in the tropical and subtropical zones have been characterized by relatively low levels of per capita income, high percentages of national income derived from the agricultural sector, a large proportion of the total work force engaged in agriculture, low levels of output per unit of labor and land in the primary sector, and high rates of population growth.

Sustained increases in per capita income and output of goods and services provide a measure of economic growth. In general, level of income is positively correlated with other desirable qualities such as food supply, health, life expectancy, education, energy, mobility and other levels of living indexes. Higher levels of economic development are usually associated with rising incomes, increases in the percentage of the total population living in urban centers, higher levels of infrastructure, and higher values of output per unit of agricultural land and labor. These facts reflect the interdependence of the farm and nonfarm sectors in the process of economic development.

Income and population growth in the nonfarm sector provide an expanded market for agricultural commodities, both for food and as inputs to industry. Shifts in demand for farm products may increase farm prices and provide an impetus for increases in production. Agricultural production may be expanded in many ways. If land and labor are plentiful resources, then agricultural output may be increased by the expanded use of these factors without an increase in their productivity. As supplies of these factors become more inelastic, increased output may depend upon the substitution of capital goods from the nonfarm sector--fertilizers, pesticides, machinery, equipment, etc.--to augment the productivity of land and labor.

Yet the interrelationships between growing urban sectors and the agricultural sector are not always complementary. A competitive relationship may exist with respect to land and water resources:

> . . .in specific localities. . .strong competition from urban uses of agricultural lands exists. This continues to reduce supplies and increase costs of land for producing winter vegetables and citrus. Loss of more of the prime lands available for production of these commodities will occur unless long-term trends are reversed. . .

> The problems are likely to become even more difficult as the rapid urbanization continues [IFAS, 1975, pp. 218-219].

This competition for resources between the urban and rural sectors is of international concern. According to the United Nations:

> There can hardly be one country in the world that is now coping adequately with the problems of urban life and growth in both a human and an ecological sense. The urban crisis is global, affecting both the industrial nations and those somewhere on the road towards urbanization, but the burden of population increase and new waves of migration from the countryside is most acute and overwhelming in the poorer-developing lands [UN, 1971, p. 7].

An indication of the magnitude of urban population growth for Latin America was recently provided in Science:

> The growth in city size has been, and will continue to be, very large indeed. By the year 2000, urban centers in Latin America are expected to contain 500 million people, with 19 metropolitan areas alone encompassing 250 million, up from 70 million in 1975 [Turner, 1976, p. 955].

While half of Latin America's population was deemed urban in 1960, projections estimate that 80 percent of the total population of this region will reside in urban centers by the year 2000 [UN, 1969, p. 39].

In the midst of this expanding population is the relatively small country of Costa Rica. How this country manages to contend with and find solutions for the problems inherent in modernization and urbanization, and how this tiny nation organizes for the economic well-being of its inhabitants may have implications that transcend its small size.

The Study Areas

In the land structure connecting the North and South American continents, ten degrees north of the equator, one finds a pair of slanted bowls of rich, volcanic soil of recent origin. This elevated intermontane basin, which lies south of an east to west arc of periodically eruptive volcanos (Póas, Barba, Irazú and Turrialba) and north of the Talamancan Mountain Range, is known as the Meseta Central or Central Plateau of Costa Rica. In the central portion of the valley, perched on an island of rich, volcanic soil and surrounded by deeply entrenched canyons which fall sharply for 60 meters below the relatively flat valley floor, lies the capital of the country, the city of San José. This urban center and its sphere of influence form the geographic focus of this thesis.

The Republic of Costa Rica encompasses 50,900 square kilometers (19,575 square miles) from its northern political border with Nicaragua to Panama on the south and southeast. It is the second smallest Central American country, larger than El Salvador, and is approximately the size of the state of West Virginia. The terrain with high mountains which reach altitudes over 3,660 meters from which numerous streams and rivers drain across lowland plains to the Caribbean Sea and Pacific Ocean.

Considering the influence of these two bordering bodies of water and its geographic location, Costa Rica can be classified as maritime with variations caused by differences in elevation and location. The relatively straight, 210 kilometer Caribbean coastline and the Atlantic plain receive year-round rainfall, constantly high temperatures and humidity from the water-laden, northeasterly Trade Winds which come across the warm waters of the Caribbean and are blocked by the mountains to the west. This region, which comprises a quarter of the total area of the country, is sparsely populated, except for the city of Limón. Tropical forests and swamps with mean maximum temperatures in low 32° centigrade (90°F) extend south to a broad, fairly level plain which narrows near Panama. Here begin the foothills of Costa Rica's highest mountain range, the Cordillera of Talamanca which rises to almost 3,960 meters above sea level. The highly irregular Pacific coastline sharply contrasts with the Atlantic side. It is almost five times the length of the Caribbean coast due to the protrusions of the Nicoya and Osa Peninsulas and numerous deep gulfs and bays. Rainfall from the southwest winds off the Pacific from May to October varies greatly. The leeward side of the Nicoya Peninsula periodically suffers from drought conditions, whereas luxuriant rain forests cover the area around the town of Golfito to the south.

Northward along the Talamancas is the hub of the country, the Central Plateau (Meseta Central) bordered on the north by the volcanic Central Mountain Range. Altitudes in the Central Valley, which vary from 600 to 1400 meters, moderate the climate considerably. Average monthly temperatures vary within 4 degrees around a yearly average of 21°C. This region has a well defined wet-dry cycle with an almost rainless season from December to April and a rainy season from May to November. Due to its climate and extremely fertile soils, the Central Plateau has historically been the economic, political and social center of the country. Even though this region comprises only about 8 percent of the total area of the country, four of the seven provincial capitals are located here. Most of the major cities are clustered along the valley floor and contain 55 percent of the total population and account for an estimated 80 percent of the total urban population.

According to the 1973 Population Census, Costa Rica had 1,871,780 inhabitants, who were unevenly distributed over the country's landscape.

Population density was 95.6 people per square mile (36.8 persons per square kilometer) composed primarily of Spanish and other European descendents, mestizos or people of mixed Indian and European bloods, Negroes, American Indians and Chinese. The annual population growth rate has dropped to an estimated 2.5 percent after a peak of 3.8 percent per year during the 1950-1960 period [Gómez and Bermúdez, 1974, p. 1]. This decline of one of the world's highest rates of population growth is generally attributed to vigorous private and public family planning programs and growing awareness among the populace of smaller family benefits. Current life expectancy at birth is over 69 years.

The economy of Costa Rica is basically agricultural, although this sector's relative shares in employment and national income are being displaced rapidly by the secondary and tertiary sectors. Foreign exchange earnings traditionally have depended upon the export of agricultural products, especially coffee and bananas, which in 1973 accounted for 54 percent of the value of all exports. Approximately a third of the nation's total merchandise is imported. Per capita gross national product in current prices for 1973 was US$ 545, and the nation's growth rate for per capita income in real terms is estimated at 4.27 percent annually. If this rate continues, then real income will triple in the next quarter decade. Although over half of the labor forcé or Economically Active Population (PEA) was employed in the primary sector in 1950, this figure dropped to slightly more than a third in 1973.

Costa Rica is divided into seven provinces: San José, Alajuela, Cartago, Heredia, Guanacaste, Puntarenas and Limón. Each province is subdivided into cantons which are composed of administrative districts, the smallest political unit of disaggregation. The seven provinces are comprised of 79 cantons and over 400 districts. The Constitution of 1949 established the current tri-part government with executive, legislative and judicial branches. The capital city of this democratic republic is San José, the dominant urban center of the nation and the central city of the San José Metropolitan Area (SJMA).

After the 1948 revolution, the Municipality of San José solicited the services of Mr. Anatole Solow, chief of the Urbanism Department of the Pan American Union to investigate the possible formation of an urban planning zone for the capital city [Herrera, 1970, p. 1]. His report entitled "Project for the Urban Development of the Capital of Costa Rica" (1949) lead to the naming of a Colombian urban expert, Mr. César Garcez, to work with the municipality and Department of Housing of the Costa Rican Social Security Bank (CCSS), forerunner of the National Institute of Housing and Urbanization (INVU). From this association sprung the first attempts at a demarcation of a National District or Metropolitan Area.

One of the first official recognitions of the concept of a metropolitan area was made by the Costa Rican Census Bureau (Dirección General de Estadística y Censos, DGEC) in their publication of the results of the 1950 Population Census.

> The city of San José, taken as the four first districts of the Central Canton has a population of 89,334 inhabitants. Nevertheless, in our eyes, the population which depends upon this city has grown more horizontally. In other countries one speaks rather of a "Metropolitan Area" following a more objective criteria which perhaps we should apply as well. This zone could be constituted as the Central Canton of San José, excepting the district of Pavas as too rural, and including the urban portions of the neighboring cantons of Tibás, Goicoechea, Moravia and Montes de Oca. The

> population thusly calculated would be 141,996 inhabitants which represent 17.73 percent of the total country. This percentage is relatively high for an area so small. To this previous figure should be added the floating population which during work days is enough to be able to consider San José as the principal commercial and industrial center of Costa Rica [DGEC, 1953, p. 8].

The official definition that evolved included not four but eight of the neighboring cantons with a total population in 1950 of 179,736 inhabitants, which represented 22.44 percent of the nation's total population.

Shortly after the creation of INVU in 1954, and the subsequent formation of the Metropolitan Area Planning Office (OPAM) within this semi-autonomous governmental agency, a subjective working definition for a metropolitan area evolved based upon topographical considerations. This definition was adjusted the following year by the Census Bureau (DGEC) to conform with administrative boundaries in order to compile comparable population figures. The topographical and political divisions were melded by INVU in the following definition of the Metropolitan Area:

> . . . the central canton of San José, the cantons of Tibás, Montes de Oca and Curridabat, in their entirety; the canton of Goicoechea, except Rancho Redondo; San Vicente and Trinidad districts of Moravia; the Coronado quadrant (present day San Antonio [Rodríguez and Beck, 1967, p. 14]); The Central, San Miguel, San Rafael, and San Juan de Díos districts of Desamparados, the cantons of Escazú and Alajuelita, except the mountainous portions of San Antonio. This wide zone covers an area in excess of 200 square kilometers or twenty-thousand hectares [INVU, 1965, n.p.].

Several years later, Ms. Cecilia Rodríguez and Mrs. Elena Terán Ferrer de Beck, graduate students at the University of Costa Rica in historical geography, began to question the practicality of the previous definitions:

> . . . this definition, eminently based on demographic factors and, therefore, necessarily liable to continuous revision, has placed us in the dilemma, upon beginning our task, of accepting it or not. This has also been reason for worry in the Urban Planning Office of INVU, where a recent study has come to confirm the expansion of the established limits [Rodríguez and Beck, 1967, p. 15].

These young scholars began to question if cities such as Santo Domingo and Heredia, which were located in provinces other than San José, should also be included within the folds of the Metropolitan Area, since they were so intimately tied to the affairs of San José. This idea bore fruit in 1974 with the San José Metropolitan Area Transport Study, a joint effort of the Ministry of Public Works and Transport (MOPT), PADCO and Alan M. Voorhees and Associates, Inc. For study purposes, a new area of approximately 563.5 square kilometers was delineated, encompassing the major population centers of the Alajuela and Heredia Provinces to the northwest and including Tres Ríos of Cartago Province to the east and south [Figure 1., MOPT-AMV #16, p. 1.2].

> The Study Area is larger than the Metropolitan Area of San José as presently defined by law; this is due to the fact that the future urban growth will certainly exceed the traditionally accepted boundaries and will affect the principal urban centers of the Central Valley directly tied to San José [MOPT-AMV, #16, p. 1].

In a recent study of this area, researchers from the University of Florida in collaboration with members of the Metropolitan Area Planning Office (OPAM) and officials in the Division of Urban and Regional Planning Office (OFIPLAN) and the Costa Rican Census Bureau (DGEC), designated 40 districts from nine cantons -- Central, Escazú, Desamparados, Goicoechea, Alajuelita, Tibás, Moravia, Montes de Oca and Curridabat -- as corresponding to the "official" Metropolitan Area [see Carvajal and Goodwin, 1977, pp. 121-132]. Time-series analysis of populations employs this areal definition. This area was also linked with corresponding census tracts, which encompass between 60 to 90 houses each. In 1973, the national territory had been divided into 4,693 census tracts of which over a fourth have been designated as corresponding to the "official" Metropolitan Area (see Appendix I). Disaggregated data at the census tract level have been employed in this thesis for cross-sectional analysis of the study area.

In order to incorporate secondary data and compare published agricultural statistics from 1955 to 1973, a slightly different, "amplified" definition of the San José Metropolitan Area will be used in this thesis. This "amplified" area includes, in addition to the "official" area established by OPAM-UF-OFIPLAN-DGEC, the following political districts:

(a) Canton Desamparados:
Districts: San Miguel, Frayles, Patarrá, San Cristobal, Rosario.

(b) Canton Goicoechea:
District: Rancho Redondo.

(c) Canton Alajuelita:
Districts: San Josecito and San Antonio.

(d) Canton Moravia:
Districts: San Jeronimo and La Trinidad.

While there exists only a 5 percent difference in total population between the two difinitions, the amplified area has two and a half times the area of the official Metropolitan Area (see Appendix I).

Time Period

The principal time frame of this study is the period of years between 1950 and 1973. Historical perspective of agricultural and urban development is presented from the Spanish Conquest in the 16th

Century until the modern era beginning in the mid-20th Century. The choice of this time period depended, in part, on data availability. Since the foundation of the Second Republic in 1948, the Costa Rican government has published information concerning demographic, economic, social and public finance statistics.

Published agricultural census data exist for Costa Rica for the years 1955, 1963 and 1973. Total agricultural and food production indexes begin in the 1952-53 period (see Appendix II). These agricultural data have been extrapolated to 1950 to coincide with the Costa Rican Population Census of that year, as well as information concerning national accounts, price indexes, property values, imports and exports.

Objectives

The objectives of the present study with respect to Costa Rica are as follows:

(a) to research the historical uses of land in order to provide a perspective of modern uses of this factor.

(b) to measure the rate of change in population, especially differential growth in urban and rural population during the period 1950 to 1973 as an indication of future demands for farm output and for urban land use.

(c) to calculate rates of change in per capita income and food consumption, as further indications of future demand for farm output.

(d) to relate growth in agricultural production to changes in land, fertilizer, labor and machinery inputs.

(e) to test the hypothesis that increased use of fertilizer and machinery have been induced in part by relatively lower prices for these inputs than for land and labor.

With respect to the San José Metropolitan Area, the objectives are as follows:

(a) to measure the rate of growth in urbanized area and describe the manner in which the urban area is expanding into the rural zone from 1955 to 1973.

(b) to describe the changes in number of farms, institutional aspects and area in farm land as the urban area has expanded.

(c) to explain the manner in which farm yields and land values have changed under pressures of urbanization and to relate these changes to public policy issues.

Preview of Succeeding Chapters

Theoretical considerations of land use, land rent, technological innovation and consumption are presented and discussed in Chapter II. A general historical analysis of Costa Rica's agricultural and urban development begins in Chapter III. This chapter analyzes the importance of the primary sector from the time of the Conquest, through the foundation of San José as a market and administrative center, the development of an export economy, and the eventual closure of the agricultural frontier as a means of expansion. Evidence of urbanization, changes in employment and consumption patterns is presented. An analysis of the changes in agricultural productivity and the shift towards land- and labor-saving technologies and capital complete the third chapter.

These changes in economic activity are related to urbanization and the expansion of urban areas and functions in Chapter IV. An analysis is conducted for population growth and dynamics in the Metropolitan Area of San José. The contemporary configuration of urban land ends the fourth chapter.

Chapter V focuses on changes that occurred in the agricultural sector within the San José Metropolitan Area under pressure of rapid urbanization. The effects of rural to urban land conversion, changes in institutional arrangements, and urban consumption patterns are studied. Finally, the spatial manner of increases in yields per hectare, fostered by technological innovation, is presented. Chapter VI presents a summary and conclusions.

CHAPTER II
THEORETICAL CONSIDERATIONS

The major thesis concerns the change in the productive use of land in the face of increasing urbanization in Costa Rica. With a rapidly growing domestic population, there is an increasing demand for space in which to live and for food production. Resource prices and land rents play a pivotal role in this analysis. A simple model of land rent under fixed quantities of land together with the concept of marginal value product of inputs and shifts in demand for inputs and outputs are used to explain the changes in the use of land and supplementary inputs.

Historical background is provided, beginning with the conquest and colonial eras when land was essentially a free resource. The agricultural sector became especially important during the period of agricultural production for export. Evidence is presented to detail the closure of the agricultural frontier which had served as the principle means of expanding production. This closure was linked with migration to urban areas and the subsequent phenomena of rapid urbanization. The concurrent changes in the economic activity of the populace, increases in per capita incomes and alterations in food consumption patterns were then reflected in terms of increased demand for agricultural products. With a fixed land base, the increase in production must come from higher yields. This process of increasing yields with inelastic land supply is further detailed for the San José

Metropolitan Area. Evidence of urbanization and urban growth is presented. The consequent changes in the agricultural sector within this area are then measured and explained.

Several assumptions and theoretical concepts are instrumental in the analysis:

(a) Producers, acting in a rational economic manner, tend to locate first on those lands of the highest quality in order to minimize costs with respect to output and to maximize net incomes.

(b) Increases in rent and land value reflect the results of an increasing demand for land, as a result of increases in demand for the output of land, while the supply function of land is fixed or upward sloping.

(c) Land derives its value from its supply and demand; whereas agricultural land is demanded primarily for its inherent fertility and productivity and location is of lesser importance, the reverse is true with respect to land used for urban purposes.

(d) The intensity of the use of capital and labor inputs increases as product demand increases and decreases with distance from the central market.

(e) The manner in which capital is substituted for land and labor is a function of changes in technology and in relative prices of inputs; subsequent shifts in factor prices may induce technological change and innovation.

According to the Ricardian concept, as time passes, production will be expanded to lower and lower yielding lands, marginal costs will increase, and net revenues, rents, and land values inside the margin will increase. Thus rents and land values will be highest on lands occupied first and will equal or approach zero at the margin.

According to concepts introduced by von Thunen, as a result of transportation costs, marginal net revenue per unit of product, and hence net rents and land values per unit of land, declines with distance from the market. If the transportation rate per unit of product and the crop yields from given levels of inputs are assumed to be constant over space, then costs per unit of output increase and net returns decrease linearly as distance from the market increases. Since, economic rent per unit area (R) is the difference between revenue and costs, these factors may be considered in a linear equation:

$$R_i = Y\ (P_y - (P_xX) - td_i) \qquad (2.1)$$

where Y is the product per unit area; P_y the unit product price; P_xX is the cost of inputs (excluding transport) times input use per unit area; t is the transportation rate per unit of production; and d_i the distance to the market from the i^{th} location. When this relationship is plotted in two dimensions it takes the form of a negatively sloped, straight line, indicating that economic rent declines linearly from the market center (C). The slope or steepness of this line depends upon the transportation rate, t. Rent has its highest value at the market and then declines to zero, beyond which production for the market is no longer economically feasible. At this point (M), termed the "extensive margin of production" [Found, 1971, p. 58], production would cease expanding. This relationship reveals a circular area with a radius from the market center equal to the distance CM, and a total area (A) equal to $\pi\ (CM)^2$ units of uniformly productive land. In a free competitive market, farmers would be willing to pay rents equal to the difference between revenue and costs. Differences from the functional relationship specified above could arise as a result of differences in land productivity, i.e., Ricardian-type differences.

The specific shape of this "bid-rent" curve or "rent function" has received considerable discussion in the literature [Dunn, 1954; Muth, 1961; Alonso, 1965; Tarrant, 1973]. As a result of the differences in net product prices at the farm, market center price less transfer costs, received by farmers, differences in production systems may occur as distance from the market increases.

Figure 1 may be used as an illustration of three separate systems which grow the same crop but with different yields per unit area, or three different enterprises, each possessing a different rent-distance function A_1, A_2 and A_3. This pattern would result in a system of three concentric zones of land use or "von Thunen rings" [Found, 1971, p. 63]. The most intensively used zone, located spatially from the market center (C) out to a radius at distance d_1, would have the highest economic rents, from R_1 to R_2. In this circle, one might expect to find a continuous cropping system, dependent upon relatively high levels of factor inputs and relatively high yields. The inner circumference of the next ring would be determined by the juncture of the rent-distance function of the intensive system (A_1) and the characteristic bid-rent curve of an intermediately productive system (A_2). This latter curve would reflect a lower level of input use as producers reduce costs in response to lower marginal revenues. Within this spatial band, the moderately intensive cropping system A_2 would yield higher rents than either high-yielding system, A_1, or the outlying extensive production system, A_3.

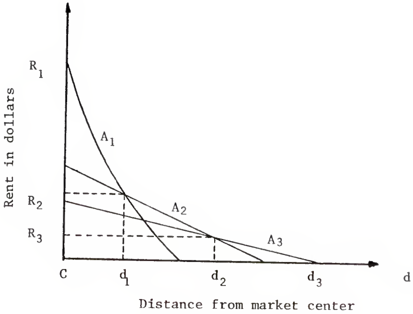

Figure 1. Demand curves for different land uses

The spatial land demand or rent curves may be used as an aid in understanding the conversion of land from rural to urban uses. As the market center increases in urban population, demand for urban land increases. As the population of urban center increases, food prices increase and producers increase yields by using additional variable inputs. Typically, a point is reached where the demand for residential or urban land uses exceeds the demand for farm uses, even when the higher land rents that resulted from higher farm product prices are taken into account.

This competitive situation between agricultural land use and urban land use has been described by Muth [1961, pp. 1-23]. Muth used differences between the price and income demand elasticities for farm products and for urban and residential services to explain the conversion of land from farm to urban uses. One case involved farms producing dairy products or fresh, perishable produce for a local metropolitan area. The demand for these products was assumed to be inelastic with respect to price and elastic with respect to income. For other commodities, such as basic grains, products were assumed to have low or negative income as well as price elasticities of demand. In another case, it was assumed that the product moved into national (or international) markets, such as the case of farms in the United States corn and wheat belts. These farms would sell only a small proportion of their total product to local consumers. Local demand at the farm level would be essentially perfectly elastic with respect to price, while local incomes would have little or no effect upon consumption. This may well be the case with permanent crop plantations especially export coffee produced in the areas around San José.

The effects of changes in demand for land upon land use under situations described above are illustrated in Figure 2. The original rent curves for urban and agricultural lands are represented by U_1 and A_1, respectively, with an equilibrium at the margin between urban and farm uses and equal rents (R_2) at d_1. Land area equal to C to d_1 is used for urban purposes and the remainder is used for farming. As urban population and incomes increase, the demand for urban land is pushed out to U_2. If there is no corresponding change in the demand characteristics of the agricultural commodity (as in the cases of inferior good and/or export crops), then the urban-rural frontier extends out to d_3 with a border rent of R_3. If the agricultural commodity produced in the area surrounding the urban core possesses favorable demand characteristics, and population and income growth increases commodity demand, as in the case of superior goods for local consumption, the agricultural rent curve would rise to A_2. The urban zone would be extended to d_2 instead of to d_3, and the agricultural frontier would expand to d_5. Border rent between the urban and rural zones would be the higher value, R_4. Thus the demand characteristics for both urban and rural land affect the direction and extent of urban area expansion.

To account for the "transitional friction" encountered in the shift from rural to urban land use, Muth [1961, p. 19] calculated that the increase in demand for urban housing would have to be approximately 1.4 times as great as the increase in demand for food products in order to expand the urban margin. From previous studies, he estimated the income elasticity of demand for housing to be between 1.0 and 2.0 and the income elasticity of demand for local food products

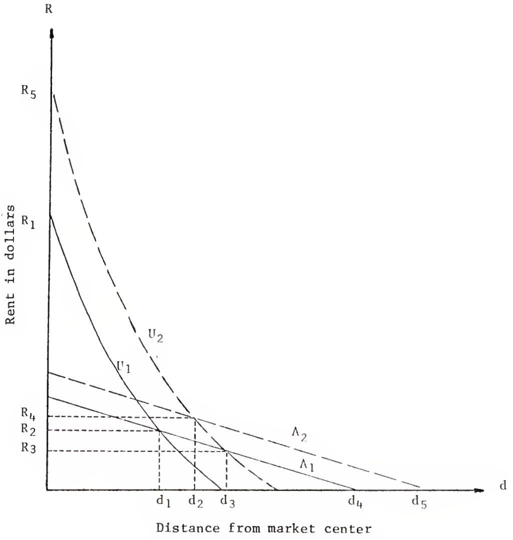

Figure 2. Demand curves for urban and rural land use under conditions of changing demand

to be 0.2. In this thesis the theoretical explanation of urban-rural land conversion is empirically tested by extending the general food case to include more specific commodity groups and their associated land use categories to explain the pattern of expansion of urban population into rural areas.

Technologies for agricultural production may be classified into four categories:

(a) chemical--such as fertilizers, insecticides, herbicides;

(b) biological--such as hybrid seeds and improved animal breeds;

(c) agronomic--such as plant spacing, depth of planting, land preparation, timeliness of operations, water control;

(d) mechanical--tractors, machinery.

These innovations may be viewed as labor-saving or land-saving in the Hicksian sense. Chemical, biological and agronomic innovations are usually yield-increasing and land-saving, and are either neutral or labor-using. Mechanical power and equipment are labor-saving and most often do not increase yields per unit of land except for favorable effects on agronomic factors such as timeliness of operations and land tillage. The manner in which innovations are induced by changes in relative factor prices and changes in product prices is facilitated by the use of the ex ante concept of a historical Innovation Possibility Curve (IPC), which envelops all presently known or potentially discoverable technologies in a given stage of scientific knowledge [Ahmad, 1966; Hayami and Ruttan, 1971; de Janvry, 1973; Schuh, 1974]. In the Schumpeterian sense, technological change can result either from a shift to a new IPC with an improvement in the stock of scientific knowledge or from new production techniques within the same IPC_t. In the first case, technological invention allows a reduction of costs with given factor prices through a shift from one production function to another, while in the second case costs may be reduced by factor substitution along the same production function with changes in relative factor prices.

For analytical purposes, a separable, two-stage production function of the form specified by Schuh [1974, p. 3] is used:

$$Y = F\ [f_T\ (T,\ K_T),\ f_L\ (L,\ K_L)] \qquad (2.2)$$

where output (Y) is a function of the sub-function f_T, composed of land (T) and land-saving capital (K_T); and the sub-function f_L, composed of labor (L) and labor-saving capital (K_L). Substitution possibilities are assumed to be high within each sub-function, but are low between sub-functions. Analysis focuses upon f_T because land-saving capital is less likely to increase yields per unit area.

Figure 3 illustrates the effects of technological change and factor substitution for the sub-function f_T. IPC_t is the innovation possibility curve at the initial time period t and I_1 represents the production isoquant along IPC_t for a given production technique. "Define AB as a unit cost line where P_T and P_{K_T} are the factor prices

$$P_T T + P_{K_T}\ K_T = 1 \qquad (2.3)$$

relative to the product price (P_y). The tangency of this price line with IPC_t and I_1 at point 1 is a point of initial equilibrium. Resources are combined in the proportion given by ray I, and Schumpeterian profits are zero" [Schuh, 1974, p. 4]. This point represents the land-intensive factor proportions. With changes in the stock of

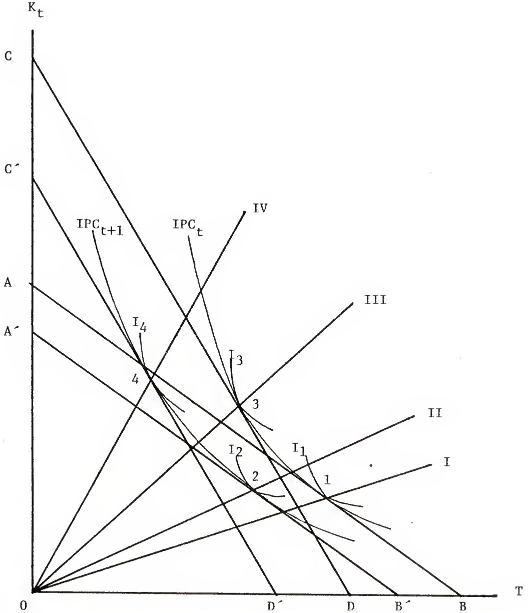

Figure 3. Innovation possibilities curves and production isoquants. [Taken from Schuh, 1974, p. 3]

scientific knowledge, IPC_{t+1} becomes available. This may represent, for example, the development of a higher-yielding variety. Whether producers attain the new technology depends upon product and factor prices and the discovery of new techniques. Assuming that applied research facilities exist, the immediate response would be a shift to the tangency of the lower price line $A'B'$ with IPC_{t+1} and I_2 point 2 where profits would be reaped.

For expository purposes, assume that product demand is perfectly elastic (as in the case of export crops with prices exogenously determined) and land is relatively inelastic in supply. Innovators, receiving profits, would bid up the price of land, with the effect that the price line AB would rotate clockwise towards CD. This shift in relative factor prices would provide an inducement to shift towards the more K_T responsive production along IPC_{t+1} and to substitute land-saving capital for land that is in inelastic supply. Other possible outcomes are represented by other points given in Figure 3 and additional explanation may be found in Schuh [1974, pp. 3-5]. These theoretical concepts are used to explain the nature of technological changes in farming that occurred in Costa Rica and the San José area.

The concepts presented in the preceding sections indicate the effects of changes in product prices on uses of inputs and the value of rents and land. The remainder of this chapter is devoted to an explanation of the effects of increases in income and population on the demand for and prices of goods and services.

Market demand originates with individual consumers. People choose among available products and services through a structure of tastes and preferences while constrained by prices of goods and services and by disposable income. In general, increases in population tend to shift the demand curve to the right. Changes in consumer preferences may shift the demand in either direction and depends upon whether the preference is increased or decreased.

As per capita incomes increase, the percentage of income spent increases on "superior goods", such as meats, milk, fruits, vegetables and processed foods, in relation to the percentage spent on carbohydrates which are usually classed as "inferior goods". As families' incomes increase, a point is reached where the percentage of incomes spent on food declines as income increases. Also, the percentage of food expenditures allocated to cereals decreases to the point where the absolute expenditures may decrease. Thus with increases in per capita incomes, the effects on demand are not distributed uniformly among goods and services.

The income elasticity of demand is expected to be greater for urban goods and services than for farm products. Within farm products the income elasticity of demand is expected to be highest for livestock products, and vegetables and may be even negative for some carbohydrates. Neither population growth nor increases in domestic income is expected to have significant effects on the demand for export production.

CHAPTER III
AGRICULTURAL AND URBAN DEVELOPMENT

The development and growth of the agricultural and urban sectors within the Costa Rican economy are interrelated. San José is an outgrowth of a convergence of a circular settlement pattern of Indians, which converged into a radial market center for agricultural goods when it was displaced by European conquerors. The early pattern of economic activity and consequent political and social structure of the Central Plateau region is based upon a von Thunenian expansion of coffee production for export. The phenomena of rapid urbanization and an urban growth which has displaced this mantle of perennial crops can be traced to the abatement of productive agricultural land, in the Ricardian sense, and to associated changes in governmental policies with regard to land settlement in the country.

As the agricultural frontier diminished, migration accelerated toward urban areas, fostered by policies of the central government. This phenomena, coupled with population increases, has resulted in a transformation of the urban sector and substantial changes within the primary sector. A shift has occurred in the proportion of the population employed in urban economic sectors and in the amount that this labor contributes to the general economy of Costa Rica. Concentration of urban inhabitants has exerted fundamental changes in the primary sector. Changes in consumption patterns, pressures upon the land resource, and the development and expansion of infrastructural and commercial activities complementary to agriculture have caused a transformation in the patterns of crop and livestock enterprises for domestic and export markets.

First, there was expansion in agricultural land to meet these changes in demand for agricultural commodities. As the limits of land area were reached, there was an increase in productivity of the land resource. This growth in productivity of the agricultural sector has been supported by a favorable price structure, a stabilization of tenure conditions, an extensive credit investment, and the availability and growth in use of yield-increasing inputs such as fertilizer, herbicides, irrigation, improved seed and livestock. These phenomena have been accompanied by a further commercialization of domestic production and a displacement of labor from the primary sector both of which are associated with urbanization.

In this chapter evidence is presented which describes and explains these dynamic shifts. More detailed explanation is offered for these processes in the San José Metropolitan Area in subsequent chapters. The first four sections compose a historical chronicle of agricultural economic activity from the time of the conquest until the beginning of the study period in 1950. This historical analysis is followed by sections which detail the closure of the frontier for agricultural expansion and the resultant city-ward migrations. An overall analysis of the Costa Rican economy during the period 1950-1973 focuses upon changes in the respective urban and rural sectors. The effects of changes in export and internal demand characteristics and the subsequent responses in agricultural production and yields conclude this chapter.

Conquest of the Central Plateau

In contrast with Spain's other New World colonies, the conquistadores of Costa Rica found neither lucrative mineral deposits nor large concentrations of Indians. This fact played a significant role in the determination of the course of Costa Rican economic and political development during the colonial period. Gold, the magnet of most Spanish migrants, was not as plentiful as Columbus had reported in his encounter with the "rich coast" in 1502 [Lines, 1961, p. 1]. The fertile upland valleys could not be economically placed under the hacienda system of sugar production, prevalent throughout the Spanish Caribbean during this period, without the labor of Indians or slaves. By the mid-16th century, Costa Rica remained the only Central American province that neither was officially conquered nor possessed a single center of Spanish population.

In 1560 the Audencia of Guatemala arranged an expedition of conquest into Costa Rica, contracting with Juan de Cavallón and an ex-Franciscan father, Juan Estrada Rávago, who provided the necessary capital to attempt to reach the famed Veragua region on the Atlantic coast. Previous failures had been thwarted by the ferocity of the Indians, the difficult terrain and especially by the problems of providing provisions for the expeditionary forces. Their plan was to split into two parties which would meet on the Atlantic coast after following different routes. Both were to leave León in Nicaragua and journey together to Lake Nicaragua. Here Rávago's group would cross the lake, follow the San Juan River by boat to the Atlantic coast, and then journey to Bocas del Toro in Panama [Fernández Guardia, 1941

p. 103]. Meanwhile, Cavallón was to travel from their place of departure, Granada, south along the Nicoya Peninsula and Pacific seaboard, and endeavor to cross the mountains that separated the two oceans where his party would try to establish a base from which to carry out the conquest.

> . . . with ninety Spanish and some African slaves; he carried along with him cattle and horses, hogs, sheep and goats, and wheat seed [Sandner, 1962, p. 28].

Cavallón's hope was to avoid the steamy jungles of the Atlantic coast, take advantage of the routes established by prior expeditions along the Pacific coast, and thereby succeed in crossing the mountains to meet Rávago on the Atlantic side.

Cavallón's mission was to found self-supporting settlements which would on the one hand, establish dominion over the province and, at the same time, provide a base of operations for further exploration. The explicit details of his agreement can be found in two principal documents which provide information concerning the business of conquering and pacifying the territory of Costa Rica as undertaken by Cavallón. The first document was the power given to Licenciado Don Alonso Ortiz de Elgueta by the Audencia, which was later transferred intact to Cavallón. The second document was Cavallón's mandate conferred to him by the Audencia and later reconfirmed without change by the King of Spain in a Royal Decree dated the 5th of February, 1561 in Toledo [Meléndez, 1961, p. 43].

> Firstly, when you have arrived in that land with the people and religious men that you are carrying, elect sites and places to populate, taking care that the land be safe and fertile and with abundant water and wood and good pastures for cattle; all of which you will distribute among the populace without occupying nor taking anything that is actually being utilized by the Indians, without their wish [Fernandez, 1886 tomo IV, p. 114].

This benign statement of settlement is followed by one with a more territorial imperative in which Cavallón's instructions were to construct houses that would secure the inhabitants and their cattle from Indian attacks. Once the houses had been built, seedbeds were to be planted and the settlers were to provide themselves with a food base by cultivating the lands, planting vineyards and fruit trees, and then search for mines of precious metals [Fernández, 1886 tomo IV, p. 144-145].

That the intent of the expedition was to establish settlements of a permanent nature is reinforced by the following citations, taken as well from the guidelines given in the Royal Decree, which established what was to become communal land or tierras baldías. This land policy played a major role in the history of Costa Rica's settlement and agricultural development.

> . . . lands for sugar mills and gardens and for vineyards and to distribute the waters and give "cavallerías" of land (1 caballería = 33 1/2 acres = 13.6 hectares) in order to raise bread and cattle farms in each town that is populated, without injury to the Indians apportioning their services and persons [Fernández, 1886 tomo IV, p. 170].

The expedition followed the Rio Grande de Tárcoles, found the Indian settlement of Orotina [Meléndez, 1961, p. 80] and reached the Central Plateau, which the lowland Indians called Abra. Here, in the center of the country, they found an extensive valley with a pleasant climate and bountiful streams of fresh water surrounded by wooded mountains [Rodriguez and Beck, 1967, p. 21]. Here

> Cavallón . . . founded the city of the Castle of Garcimuñoz on the Turracares plain on the right bank of the River Ciruelas in the last day of March, 1561 [Gonzalo Víquez, 1958, p. 490].

The decision by Cavallón on the location of Garcimuñoz was not the most propitious. The western section of the Western Central Plateau has never been highly populated not even in pre-Columbian times. This fact reflects its poor soils which are eroded by the Trade winds that funnel through the Landecho Valley [Monge, 1959, p. 62]. Probably due to the fact that Cavallón had chosen a location in the poorest environmental area of the Central Plateau, his party was initially left unmolested and generally well received by the Indians under the command of the Chief Accerri, whose neighboring tribe resided in the southern portion of the Plateau [Rodríguez and Beck, 1967, p. 22].

Indian and Colonial Settlement Pattern

The Indian population of Costa Rica was always rather sparse and their plantings of maize provided just enough for their own sustenance. Their settlements were located in the geographically specific belt of terraces nestled between the valley floor proper and the mountain ranges that surrounded the intermontane valleys which together compose the Central Plateau. Each village was constructed with mountains on one side, the insipient part of a stream bed on another and relatively flat terraces which extended out on the adjoining sides. These Indian settlements were located between 1100 to 1800 meter elevations along the extremities of the western valley, a pattern that is replicated first in the higher eastern Guarco valley between 1400 and 1800 meters, and followed as well at the 800 to 1100 meter levels along the Reventazón River valley. There were reasons for this locational pattern.

(a) Although the surface of the Central Plateau is surprisingly flat, the numerous rivers that flow from the volcanic mountains of the Central Mountain Range and down the slopes of the Hills of Escazú, have entrenched their courses in the unconsolidated volcanic rocks to depths of over 61 meters [Andrade, 1967, p. 11]. If the Indians had wanted to travel through this configuration, quite possibly the most efficient albeit longer route would have been along this lower rim belt, which provided an optimum path of least resistance, by avoiding the steeply entrenched stream valleys, as well as the difficulties of traversing the mountains.

(b) Later flooding mishaps such as those which were to confront the Spanish settlers in the eastern Guarco valley [See Meléndez, 1962] had probably taught the Indians the judiciousness of selecting sites which were located above the valley floor. By the construction of villages farther toward the origins of tributary streams, they could be assured of a water source without the flooding that periodically plagued the areas of the larger, trunk streams along the valley floor.

(c) These sites were probably some of the most strategically defensive locations, given the constraint of the type of land necessary for indigenous corn cultivation. Protection would be afforded from the mountains which rose up behind the villages and, from their vantage point on the mountain flank, they would have been able to spy attackers who approached through the valleys. This form of dispersement also allowed for the maximum distance between tribes.

The peaceful relationship between Spaniard and Indian was short lived. Imported food supplies were quickly diminishing and the sterile plains around Garcimuñoz were not yielding crops envisioned by the original contracted agreements.

> The Spaniards, like good Europeans, were accustomed to consuming wheat. Before coming to the Americas they had not known corn. Nevertheless, upon discovering and conquering these lands, upon living among the Indians, they nourished themselves with corn as well as other vegetables. In the whole continent at the beginning of the conquest, Spaniards and Indians fought for the possession of this coveted grain: some to snatch it away and the others to defend it [Monge, 1958, p. 58].

Such was the case in Costa Rica as well. When Cavallón sent out parties looking for provisions, especially corn:

> taking them by force from the Indians who, as is natural tried to defend their meal; and since Cavallón was high-handed, hositlities between the invaders and the owners of the land quickly broke out [Fernández Guardia, 1941, p. 108].

It was not long before conflicts arose between the Indians and the Spaniards. The reason for these insurrections, that were to continue almost unabated until the death of the new governor, Coronado, in 1566, was corn. The Spaniards raided the Indians' crops and carried it back to the new fortressed settlement of Cartago. Harvests for both white man and Indian had been scant and there was virtual famine in the country. As the hostilities continued to spiral, the planting and harvesting of the precious crop became more difficult. Soon rebellion spread from the surroundings of Cartago and the Indian tribes confederated and intensified their onslaughts. Many of the *conquistadors*, tired of the stubborn, continous attacks, lost patience and left for other parts, especially those who had originally come with visions of gold and slaves. The new province would have been depopulated if it had not been for reinforcements sent from Nicaragua [Fernández Guardia, 1941, pp. 140-141].

The new governor, Don Perafán de Rivera, who arrived two years after the death of Coronado in 1568, was given the task of pacifying the province [Monge, 1958, p. 65]. With him came more reinforcements who quelled the attacks around Cartago and mounted offensives and corn-raiding parties first to the east as far as Tucurrique and then to the west to "Abra o Curridabá, a Barba, Ujarrás y Toyopán" [Fernández Guardia, 1941, p. 142]. Armed domination continued outside the Central Plateau as excursions were sent to the south and east [Sandner, 1962, p. 28].

The worst problems began for Rivera when a semblance of peace had been achieved. The soldiers, who had fought the Indian attacks, and encountered food deprivation and forced marches, demanded to be rewarded with forced Indian labor under the system known as repartimiento and threatened to desert the province if their demands were not met, [Fernández Guardia, 1941, p. 143].

> In effect, from the beginning of the Conquest, the heads of the expeditions...not only founded villages and cities, ordered the robbing of corn, looked for gold as the occasion arose, and propagated Christianity, but also distributed among his men the Indian towns and lands ...each worthy Spaniard was an `encomendero` (Because he had an "encomienda", that is a town if Indians). Each Indian was charged a determined amount of money yearly (nine, ten or more pesos, depending upon the case or the tax). If the town's people did not have money, then they paid in grain or animals, and lacking these, could pay the tribute with personal labor. For the Spanish, the last form of payment was the most convenient, because in this way they counted upon workers to work the land and mines. The conquistadores abused the energies of the aborigenes. Thus was born a true regimen of slavery [Monge, 1958, pp. 72-73].

The Indian name "Curriraba" appears in one of the documents issued by Perfán de Rivera in which instructions were given for the encomienda in 1759. This area corresponds to the present day canton of Curridabat which lies in the southeastern corner of the Metropolitan Area. With the Indian population subdued, colonizers began to spread out into the valley. The first lands to be tilled were those around Cartago, where wheat was being grown by 1577 [Andrade, 1967, p. 38].

The first mention of land which today belongs to the Metropolitan Area appears to be in Mata Redonda, one of the eleven districts of the present-day Central County of San José, which is referred to in an early land sale folio. The name is derived from a similarity to "certain extensive valleys in Spain, covered with low vegetation, or in other words, a savanna" [Quesada Vargas, 1964, p. 54]. In 1572, Governor Perafán de Rivera decided to change the site of the provincial capital to Mata Redonda, where it remained for two years before returning to Cartago [Rodriguez and Beck, 1969, p. 22].

The settlement pattern was one of clusters of population located near native Indian villages, frequently with the original Indian name corrupted into a Spanish spelling, which were separated by large expanses of unoccupied territory. This pattern is typified by the district of Ujarás in the southern portion of the Guarco Valley, which formed the southeastern frontier at the turn of the 17th Century, as well as by the northwestern frontier located in the district of Barba, where the present cities of Heredia and Alajuela are located. In between these two clusters was the Pacacá region, just north of the present town by the same name, where today we find the cities of Escazú and Santa Ana, Asserrí and Curridabat. Today these towns forn, respectively, the southern and eastern borders of the Metropolitan Area, and the Indian-named villages of Cot and Tobosí around Cartago. The area which corresponds to San José remained as a virtual island of fertile soil, separated from these circular settlement patterns by deep gorges. The spread of colonization and the occupation of the Central Plateau can be traced in Figure 4. The only references of organized "urban" settlements other than Cartago were villages established by Franciscan friars for the conversion of Indians to Christianity. The first of these villages, called reducciones, was established around the hermitage constructed at Curridabat in 1575, which was to become the second oldest parish in Costa Rica [Rodriguez and Beck, 1967, p. 22]. The Spanish colonizers soon followed, and in 1607 the first reference of Spanish settlement in this area is made concerning the ranch of Juan de las Alas which consisted to two thatched huts, two hundred head of cattle and forty tamed horses. Other records show the sale of a wheat flour mill operated in Barba by an Indian from Curridabat [Andrade, 1967, p. 38].

The first view of this developing network of clustered settlements is found in a report made by Governor Rodrigo Arias de Maldonado to the King of Spain in 1662. The Pacacá district, which then measured six to seven leagues round (1 league ≃ 3 statute miles = 7.4 kilometers), possessed 20 wheat and cattle farms belonging to Spaniards and half-castes; in Barba, a district of 6 leagues, were to be found more than 80 corn and cattle farms and three flour mills run by Spaniards, half-castes and mulattos; and in the four leagues surrounding the Aserrí and Curridabat district, there were 80 wheat and cattle farms and two flour mills [Fernández, 1886, Vol. VI, p. 293]. By 1967, Curridabat was comprised of 29 Spanish families, by 1713 there were 36 houses with 137 inhabitants and in 1739 its population had grown to 153 persons. The Spanish population continued to live in dispersed rural

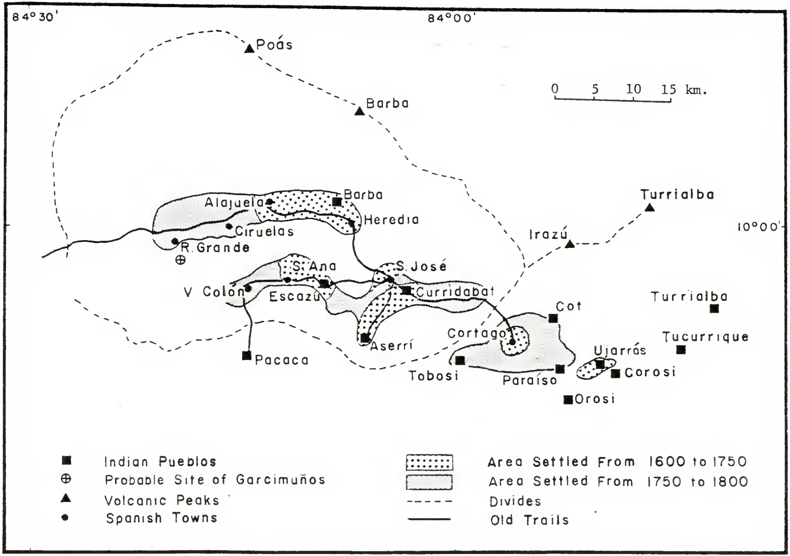

Figure 4. Colonial settlement configuration in the Central Plateau of Costa Rica

clusters, where land use within the expanding clusters was extensive [Andrade, 1967, p. 39].

Improvements in transportation radically altered the settlement pattern of the Central Plateau. Roads and trails soon connected the small concentrations of people. A glimpse of the conditions of the lives of the people and the backward march of urbanized life in Cartago is portrayed by Governor Don Diego de la Haya Fernández in a letter to the King of Spain in 1719:

> This capital contains a church, and with the aid of the parish, a convent of Saint Francis, two hermitages and 70 houses fabricated of dirt adobe and covered with tile...In the midst of the few houses which are found in this city, many less are actually inhabited, for the residents have haciendas in the surrounding rural areas where they ordinarily reside due to the consummate poverty of the country, as there are more than 300 families that are in the hinterlands, the most in thatched huts, dependent upon precious food stuffs, raising their four head of cattle and making their plantings of corn; and they only come to the city on the festive days to hear mass, one being certain that on the rest of the days only 10 or 12 men may be found there [Fernández, 1886, Vol. V, p. 478].

Northwest along the royal highway, Spanish colonizers were found settled along the river banks where they lived in miserable economic conditions:

> From this city (Cartago), by the Royal Highway towards the Virilla and Barba valleys, with a distance of four leagues, the settlements are found in the flat lowlands in the same state as those who inhabit the areas surrounding the city of Cartago.
>
> And continuing along this same path, ten leagues from this city, is the town of Barba composed of a church and eight thatched huts...all of which is found in a very prodigal valley, scattered with cattle and infinite houses with the same Spanish families that inhabited said lands with the same misery as their ancestors [Fernández, 1886, Vol. V, p. 485-486].

The economic conditions were thoroughly depressed as evidenced by the lack of imported items. De la Haya mentions this in a reference to the dress of the inhabitants:

> . . . and generally all dress rustically, the women of the principal families contenting themselves with skirts of goat, rough flannel shirts and white hats, without them being familiar with cloaks, jewels nor rings, because they neither use them nor could buy said accessories: what I have been reminded of continually, without being able to remedy the lack of notable necessities at every step of the way, not only among the poor inhabitants of this city and its surroundings, but in the rest of the province as well [Fernandez, 1883, Vol. V, p. 482].

It was from the midst of this depressed economic condition that the small crossroads chapel at Virilla was to be transformed into an insipient urban market cluster with the Spanish name of San José.

Colonial Economic Conditions and the Founding of San José

The end of the 17th and first half of the 18th centuries was one of the worst economic periods in Costa Rican history. The country was virtually an outpost, isolated from the rest of the world. Trade with other European countries and other colonies was prohibited by Spain. Roads that were once kept open for flows of goods were deliberately left in ill-repair as a defense against Indian and pirate attacks. Everywhere there was poverty. The farmers of the Central Plateau were faced with the alternative of starvation or division of the land into small subsistence plots on which they themselves labored. The resultant agricultural system, similar to that used by the Chorotega Indians of the Nicoya region, produced corn, beans, and cotton, used cacao as the measure of exchange for goods, and instilled a heritage of small, independent farmers. Even though an abundance of land was available, the exploitative capacity of the colonists was minimal, and population barely grew.

Toward the middle of the 18th Century, the congregation of white inhabitants into small village settlements was started. Colonial cities were slow to develop and did not play a dominant role;

> The city, which is the geographic basis and material sign of a robust economic life, did not play an important role this epoch. The chronicles tell us that the neighboring people only came into the towns on Sundays to hear mass, participate in fiestas and organize meetings . . .the city was for relaxing, and the model of everyday life, the countryside: life was definitively rural, and the phenomena of agricultural, livestock and agro-industrial production never intensified sufficiently in order to provide a basis for urban life. It is curious to note, on the other hand, how it was the town that drove the economy, and how its formation was originally due to outside economic factors which intervened [Facio, 1942, p. 30].

Ecclesiastical authorities were distraught by the fact that very few people attended religious functions and only several families settled around the parish churches. In 1750 the military was ordered into the countryside and forced the people to settle around the churches. Thus was the beginning of both Heredia and San José. In Heredia, as in Cartago, sharp social differences existed among the population. Sections of the villages were set aside for the hacienda-owning class and others for the laboring class. This was not the case in San José where fertile land was available to all who could cultivate it [Stone, 1975, pp. 53-58].

Subsistence farmers ventured into tobacco production in the early 1700s. It was traditionally grown in the entire Central Plateau with concentrated plantings around San José and Heredia. After these cities were consolidated by the military, Spanish authorities conceded the tobacco monopoly to the Captaincy General of Guatemala of which Costa Rica was a province. In 1766 Guatemala granted Costa Rica the monopoly for the Captaincy General in an effort to help it regain a degree of prosperity. As a result of this concession all tobacco exports had to be inspected, weighed and taxed [Fallas, 1972, p. 28].

The tobacco factoria, or inspection building, established in San José in 1781 was Costa Rica's first colonial economic institution. The effects of its foundation were felt in political, social and geographical as well as economic terms. The incipient governmental structure gained power from tobacco rents. The ecclesiastical decision to locate the tobacco inspector's office in San José converted San José from an outpost of Christianity to a classic market center, and laid the foundation for the new town that became the political and dominant cultural center of Costa Rica. San José was the focal point for the two main transportation arteries that the colonists had established across the Central Plateau (Figure 4) [Nunley, 1960, p. 7]. Around this crossroads town were founded large plantations of tobacco which established a prosperity and commercial advantage for the inhabitants of San José [Fallas, 1972, pp. 42-43].

By the end of the colonial period, colonists had extended settlements to fill the eastern and western portions of the Plateau and advanced on the northern section of the Candelaria Hills. At this point in time, three hundred years after discovery, Costa Rica began its first stable economic growth. As Waibel pointed out:

> We come to the interesting conclusion that toward the end of the colonial period only about one-eightieth (1/80) of the present-day area of Costa Rica had any

> considerable settlement; the remainder (with exception of Guanacaste, which in colonial times belonged to Nicaragua) was practically unoccupied [Waibel, 1939, p. 546].

With the advent of Independence and a decline of the tobacco industry, a major shift in man-land relations took place. The introduction of coffee culture was to stimulate not only a tremendous period of growth and expansion onto unoccupied land but also caused fundamental economic, social and political alterations as well.

Coffee Boom and Land Policies

Costa Rica's public domain lands (*terrenos baldíos*) have been an instrument used by the government to relieve economic and social pressures. These lands have been used as a source of public revenues, as a means of compensating citizens for special services, and as a solution to problems of unemployment and social unrest during periods of economic stress. Governmental policies concerning land tenure, the availability of land for homesteading, production credits and market efficiency have had profound effects upon urban concentrations as well as on rural settlement patterns.

Such was the case in 1821, when the municipal government of San José (*ayuntamiento*) distributed coffee seedlings to poor neighborhoods and allowed those who lacked land to inhabit the surrounding *terrenos baldíos* in order to stimulate production. Ten years later, the national government declared that whoever had planted coffee on these public domain lands for five years could obtain property ownership. The results of these policies on settlement patterns of coffee growers around San José and within the Central Plateau can be noted in Figure 5. By Independence in 1841, coffee plantations had expanded into the present-day Metropolitan Area [Andrade, 1967, p. 92a].

Coffee's initial impact was to reinforce and broaden the minifundia, or the pattern of small land ownership, that had been traditional since colonial times. Farmers were industrious and their farms were essentially homogeneous. Markets were small and local with a limited variety of goods. This whole scheme began to change radically with the beginning of coffee exportation in the 1830s.

Commercial trading companies, casas mercantiles, were organized to arrange for the export of coffee and the import of consumer goods from the exterior. These traders also began channeling credit funds made available by British merchants anxious to hasten the growth of coffee production. With control of the cross-flow transactions of credit, goods, and coffee, this small group of families began to acquire power and wealth. Capital-intensive technological innovations in cultivation and processing of coffee, which began in the mid-1850s, further concentrated this power and consolidated the traders' position in the changing structure of a growing export economy.

Small-scale producers and proprietors who defaulted on loans were driven into an emerging group of landless laborers. Fluctuations in an externally determined pricing structure, which evolving latifundistas could endure, caused small- and medium-sized farmers to fall into the growing worker class. Labors became further divided, the productive process became more complex, and the once homogeneous society of small haciendados disappeared [Silva-King, 1977, p. 9].

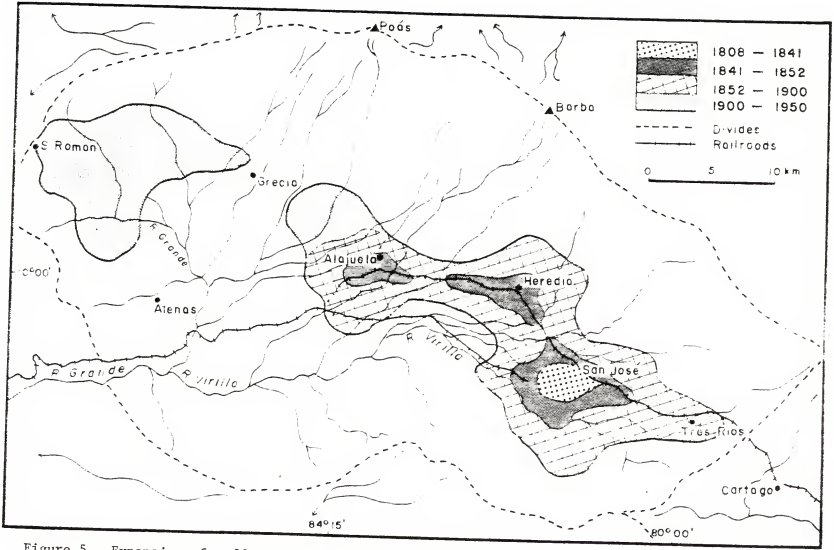

Figure 5. Expansion of coffee plantations in the Central Plateau

Construction of railroads to the Atlantic and Pacific coasts coincided with the formative stages of the coffee economy in Costa Rica. Coffee production formed around the principal population centers of San José, Heredia and Alajuela in a manner resembling the von Thunen rings transfigured by topographical and transport considerations. As foreign trade developed with transportation improvements, these cities along with Cartago developed strong internal trade functions, serving as collection points for coffee and markets for imported commodities.

This market function became larger and more specialized as the coffee boom continued. Lands that traditionally had been held in forests or used for the production of wheat and tobacco were outbid by the increasingly competitive demand for the new export crop. Commodities that were once internally grown for the domestic market were imported. Such was the case of local wheat cultivation, which essentially disappeared from the Central Plateau when it could be imported from California and Chile at a lower price. As prosperity began and economic standards rose, the domestic market centers developed as points of distribution of imported foreign goods in exchange for coffee to be exported to Europe [Andrade, 1967, p. 97].

The group of latifundista cafeteros or large-scale coffee growers became synonymous with governmental policy. From their ranks came a succession of political leaders whose influence further strengthened their position. Land concentration continued with a series of laws in the second half of the 1800s, which were intended to pay for public services and to cancel outstanding governmental debts by granting public lands.

During this period, most of Costa Rica's population remained concentrated in the Central Plateau. Even though small farmers had been displaced by the process of consolidation of productive coffee land among wealthier landowner-traders, foreign demand for coffee was high, and relatively high labor wages were being paid. The high demand for labor in coffee production served as a disincentive to internal migration and colonization efforts beyond the Central Plateau.

An exception to this case was effected by the codigo fiscal, or Fiscal Code, enacted in 1885. This law was the first major comprehensive legislation dealing with public domain land. Any person not having legal title to land in possession was permitted to obtain ownership of up to 50 hectares by a declaration in court that the land was being cultivated [Saenz and Knight, 1971, p. I-2]. The inhabited areas of the Central Plateau which supported large populations with this surplus of new wealth, began to feel the pressure of population. Migrants flowed through the mountain passes, as the first major wave of spontaneous colonization of land beyond the Plateau took place. Colonists migrated in a centrifugal pattern. Settlers pushed eastward toward Turrialba along the valley of the Reventazón River, northward toward Zarcero and Villa Quesada, to the south in the isolated interior regions of San Marcos de Tarrazú and Santa María de Dota, and began a strong migration toward Guanacaste and the Nicoyan Peninsula to the northwest [Sandner, 1962, pp. 35, 155].

Migratory movement increased with the rising cost of living. As coffee land displaced subsistence crops, food grew scarcer and relative prices rose. The population became increasingly dependent upon imported foodstuffs. With the "bust" of the coffee boom at the turn of the present century, wages dropped to a fraction of previous levels, and unemployemnt and social unrest began to grow. During this period of economic stress, caused by world-wide lowering of coffee prices and disruption of trade during the First World War, the unemployed and marginal farmers no longer received the benefits of the monocultural economic system of the Central Plateau and were simply told to find their own solutions in the outlying public lands.

The government's principal response to this problem was to open up public domain lands and urge the settlement of new regions through passage of a series of homestead laws. The first homestead law, _Ley de Cabezas de Familia_, was enacted in 1909. This law entitled heads of families to claim up to 50 hectares of land. Claimants were required to clear and cultivate at least one-fifth of the area claimed and to live on it for at least three years, after which time the title could be recorded. Similar legislation was passed in 1924, 1934, and 1939, for plots varying in size from 20 to 50 hectares, with differing requirements as to the duration of possession, cultivation, and registration. Unfortunately, little effort was made by the government to survey the undeveloped public domain lands or to keep track of land grants. Even though the homestead laws provided a means for legalizing claims, most settlers never bothered to present petitions even if they met the requirements. The policy seemed to be that public domain land belonged to those who cultivated it [Saenz and Knight, 1971, pp. II - 4 - 7].

That homestead laws were enacted, and subsequently not controlled, has contributed to today's squatter problems in Costa Rica. Another factor was the practice of compensation to citizens for services with large tracts of land, even though the grantee had no intention to utilize this land for agricultural purposes. Landless and small farmers, who found unused public domain lands increasingly difficult to obtain, began to occupy numerous large, unattended farm tracts, claiming that the land belonged to those who labored on it.

This situation was conducive to the enactment of the Ley de Ocupantes en Precario (Squatters Law) and the Ley de Intercambio (Law of Interchange) in 1942, whereby the government was to buy squatter-invaded farms from their owners and pay for these lands with other lands in unsettled frontier zones. Salazar cites examples in which "invaded" farms sold for several hundred colones per hectares, and new lands were traded for as little as two colones per hectare. It was not unusual for a farm of a few hundred hectares to be traded for as much as 10,000 hectares elsewhere [Salazar, 1961, p. 105]. Unfortunately, this legislation did not stem the tide of squatters or parasitos, those who invade titled properties. Estimates in 1963 placed their number as high as 20,000 persons [Saenz and Knight, 1971, p. 8].

In an effort to deal with this problem, laws in 1961 and 1962 created the Institute of Land and Colonization (ITCO), whose primary functions were to legalize the condition of the squatter, halt this disruptive practice, and preserve the nation's remaining unused public lands. ITCO's main thrust has been to legalize the tenure status of numerous squatters. The process has been slow and costly, and by 1968 an estimated 17,000 persons remained in illegal tenure status. Resettlement projects have been expensive and less successful. By 1967, ITCO had established 16 different projects on a total of 20,234 has. of arable land, but the actual number of persons resettled was unknown [Blutstein, 1970, p. 229]. Seven years later, the Institute published data which indicated that 1,241 families had been resettled in colonies with an extension of 35,411 has. at a cost of over $2.5 million of which less than 1 percent had been recovered [ITCO, 1974a, pp. 2, 48].

Closure of the Agricultural Frontier

If the quality of life as reflected in economic terms is to remain constant, then population growth in a country must be compensated by an expansion of production. Furthermore, if the goal of the national government is to increase per capita consumption and income, then productivity, or production per capita must increase as well. Agricultural production may increase by either an expansion of the area cultivated, which implies that more land must be brought into production, or by an improvement in the productivity of land. The first of these alternatives is a growth phenomenon whereby lands that have been in fallow are brought into production or, at a comparatively greater cost, new land is cleared or irrigated and prepared for cultivation, which in Costa Rica has traditionally been the role of the public lands. The second alternative, augmenting productivity with respect to land, is essentially a developmental concept. As stated simply by Heady:

> The economic development of agriculture is nothing more than the use of more capital resources, in substituting one form of capital for another or for land or labor and in increasing output [Heady, 1968, pp. 60-61].

In this section, the first alternative will be examined by focusing on the expansion of land resources for agricultural production and the consequent reduction of the exploitative frontier. When land expansion is viewed in the Ricardian sense of fertility, the implication for implementing the second alternative by national policymakers, that of increasing the productivity of the land resource, becomes more apparent.

Farm land and the number of farms in Costa Rica have continued to expand but at a steadily decreasing rate in recent years. In 1955, slightly over 1.85 million hectares (4.58 million acres) were classified as farmland which represents 36.4 percent of the total land surface of the country. Table 1 shows that, of this farm area, 13.7 percent was used for annual crops and fallow, 8.4 percent was planted in permanent crops -- predominantly coffee, sugar cane, bananas and cocoa -- 39.0 percent was in pastures and the remainder was in forest, brush or other uses such as farm buildings and roads.

Between 1955 and the next agricultural census in 1963, farm area expanded at an average compound annual rate of 5.5 percent. Three-quarters of this growth in farmland was due to increases in land for pasture and forest, enterprises typical of frontier expansion which also reflects the needs of a growing urban population for improved diets and construction materials. The expansion of farmland was fostered by a series of liberal settlement and homestead laws, described in a preceding section of this chapter, the institutionalization of public land reform measures through the creation of the Land and Colonization Institute (ITCO) in 1962.

Table 1. Area and percentage of total land use by categories, Costa Rica, 1955, 1963 and 1973

Item and unit	1955	1963	1973
Number of farms	47,286	64,621	81,562
Total farm area (ha.)	1,851,979 (100.0%)	2,668,077 (100.0%)	3,122,454 (100.0%)
Annual crops and fallow (ha.)	253,897 (13.7%)	351,200 (13.2%)	283,309 (9.1%)
Permanent crops (ha.)	155,496 (8.4%)	200,468 (7.5%)	207,150 (6.6%)
Pasture (ha.)	722,657 (39.0%)	935,708 (35.1%)	1,558,053 (49.9%)
Forest & brush (ha.)	676,769 (36.5%)	1,097,137 (41.1%)	1,000,088 (32.0%)
Other (ha.)	43,161 (2.3%)	83,563 (3.1%)	73,853 (2.4%)

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

After an analysis of the 1955-63 intercensal period by the Ministry of Agriculture (MAG) and the National Planning Office (OFIPLAN), there was an official recognition of increasing pressure on Costa Rica's land resource.

> The availability of land suitable for development of profitable agricultural activities may begin to constitute a serious problem in the near future. A high percentage of the land is not suitable for permanent agricultural exploitation. And if uncontrolled deforestation continues, as well as spontaneous 'colonization' of new areas by peasants...who establish themselves on land previously abandoned due to rapid soil depletion (inadequate for permanent agriculture), in short course the rest of the country's great forest wealth will also end [MAG-OFIPLAN, 1965, p. 42].

During the next decade, the average annual rate of increase of land in farms was only 1.7 percent. Area in forests decreased by 8.8 percent, land in annual crops and fallow decreased by 19.3 percent and permanent cropland increased only at an annual rate of 0.3 percent. The only substantial gain was registered in land for pasture, which increased by more area than the total increase in farm acreage. By 1973 almost half of Costa Rican farm land was in pasture, which reflects changes in domestic demand for meat products and increased export demand for beef.

This decrease in the rate at which land was being added to farms was due in large part to the rapid reduction of land available for expansion. As shown in Table 2, less than half of the land that could be utilized for production in 1955 was being used. By 1973 this figure had reached 80 percent of available land. Farm land had increased by almost 70 percent while the area devoted to urban populations had increased over three and a half times.

Of vital importance is not only the quantity of land, but the

Table 2. Estimates of land distribution in use, reserves and non-productive uses, Costa Rica, 1955 and 1973

Category	Area		Percent of Total	
	1955	1973	1955	1973
	--in square km.--		---percent---	
Land in use or reserves				
Farm land	18,520	31,225	36.4	61.3
Urban zones and highways	410	1,457	0.8	2.9
Forest and coastal reserves (decreed & recommended)	8,201	8,201	16.1	16.1
Rivers, swamps, lakes, etc.	2,212	2,212	4.3	4.3
Subtotal	29,346	43,095	57.7	86.7
Land in other uses or non-productive				
Private property	11,552	(a)	22.7	(a)
National property	10,002	(a)	19.7	(a)
Subtotal	21,554	7,805	42.3	15.3
Total area of National Territory	50,900	50,900	100.0	100.0

a/ Data not available.

Sources: Ministry of Agriculture and Costa Rican Census Bureau quality and fertility of the soil in the Ricardian sense. Inherent productivity of land used for crops and livestock enterprises depends not only upon the space available, but upon the complex interrelationship of natural resources of the region: soil characteristics, such as structure, porosity, water holding capacity and nutrient content; climatological regime; and topographical or land surface characteristics. First approximations of potential land use area by productive capacity were estimated for Costa Rica by a team from FAO in 1964 (Table 3) [Plath and van der Sluis, 1967, p. 3]. According to their classification, 22.7 percent of the land area had a highly productive potential for agricultural enterprises, 29.8 percent was usable for moderately productive cropping and the remainder was deemed suitable for marginal production and managed forest activities.

By 1963, forest land in state and coastal reserves as well as on farms had reached the recommended capacity. Under the Ricardian assumption that the most fertile lands are brought into cultivation first--justifiable in the case of Costa Rica where human settlement originated on the best quality land--and excluding forest resources, it can be seen that in 1955 agricultural land use for human food consumption occupied all of the land potentially suitable for intensive agriculture; for the years 1963 and 1973, these figures had risen to 58.8 and 79.5 percent of land of high and moderate productive capacity, respectively. If expansion of farmland continues at an average annual rate equal to 3.28, the potential supply of land for agricultural expansion, even land marginally suitable for farming, will cease to exist within the next decade. The consequence of this closure of the agricultural land frontier for expansion of production

Table 3. Potential land use area and percentage of total by productive categories, Costa Rica

Category	Area	Percentage of area
	square kilometers	--percent-
I. Highly productive potential		
Annual crops	7,737.3	15.2
Perrenial crops	3,810.0	7.5
II. Moderately productive potential		
Annual crops	2,502.8	4.9
Perrenial crops	12,654.2	24.9
III. Low productive potential	5,281.7	10.4
IV. Forests	18,804.0	37.1
Total	50,800.0	100.0

Source: Plath and van der Sluis, 1964

in Costa Rica was indicated by the FAO study:

> ...as agriculture develops and becomes more intensive (greater application of capital and/or labor in each area)...natural resources become less important, while man-made resources (roads, markets, technical knowledge) increase in relative importance [Plath and van der Sluis, 1967, p. 5].

The implication of increases in land productivity to meet consumption demand is further illuminated by an examination of farm land area on a per capita bases. In the years from 1955 to 1973, for each additional inhabitant, productive area expanded by 1.28 hectares (3.50 acres) of which 1.06 hectares (2.62 acres) was cropland or pasture. In 1950 there were 1.90 hectares (4.69 acres) of farm land per capita which dropped to 1.67 (4.13 acres) per person in 1973. If current trends in population growth and land use continue unabated, per capita farm land area will be 1.23 hectares (3.04 acres) by 1990, and productivity per land unit will have to increase by 54 percent from its 1955 level to sustain per capita consumption at present demand levels. The changes in the productive capacity to meet this demand, and the effect of a growing urban population upon changing consumption patterns will be dealt with in subsequent sections.

Migration and Urbanization

The closure of the agricultural frontier has forced a change in the migratory movements of Costa Rica's growing population. During the last four centuries, most of Costa Rica's population has been concentrated in the Central Plateau. Traditionally, the migrations of major importance have occurred among rural zones. Cityward migration is a modern phenomena, where growth in urban centers had previously been attributed to natural growth, that is births less deaths. San José has served primarily as a point of departure for migratory flows toward rural frontier land, either within the Central Plateau or outward to the coastal plains. An analysis of census data up to 1950 demonstrates a systematic decline in the proportion of the total population located in the Central Plateau with increases in the proportion that reside in the rest of the country [Zumbado and Neuhauser, 1977, p. 73].

By 1963, a firm trend of migration towards cities had been established. This trend shows that predominantly urban cantons of Costa Rica (those with an urban population of 65 percent or more) had a net migration rate of 11 percent, while moderately urban cantons (between 30 and 65 percent urban) and cantons of a predominantly rural character (less than 30 percent urban) experienced net losses of population at a rate of -0.05 and -0.06 respectively [Carvajal and Geithman, 1974, pp. 106-107]. In the last two and a half decades, the movement of people out of the Central Plateau has been reversed with the effect that migration now is from rural zones and small towns toward the Metropolitan Area [Bermudez, 1973, p. 21].

The effect of this change in migration has caused a proportional increase of the percentage of the total population now in the Metropolitan Area and the Central Plateau (Table 4). An estimated 56.8 percent of the almost two million Costa Ricans in 1973 lived in the Central Plateau, and a quarter of the total population resided in the San José Metropolitan Area. While in 1950 a third of the country's residents were classified as urban, this proportion had increased to

Table 4. Total and urban population of selected geographical regions, Costa Rica, 1950, 1963 and 1973

Area	Population		
	1950	1963	1973
	-----------thousands---------		
Costa Rica			
Total	800.9	1,339.3	1,871.8
Urban	268.3	460.5	760.1
Central Plàteau	446.6	742.3	1,063.8
San José Metropolitan Area			
Total	179.7	323.6	478.0
Urban	146.1	257.2	401.0
City of San José	86.9	101.2	91.7

Source: Costa Rican Population Census, 1950, 1963 and 1973

40.6 percent in 1973. Over half of the urban population resides in the Metropolitan Area.

Urbanization may be defined as a relatively higher rate of population growth in urban zones than in the rest of the country. Based upon the growth rates presented in Table 5, Costa Rica has been in the process of urbanization since the 1950-1963 period when urban population increased by an average 5.51 percent annually while rural sectors had a 4.96 yearly percentage increase. This difference was more prominent in the decade 1963-1973, when urban zones grew at more than double the rate of increase in rural population. The compound rates of annual growth were 5.01 and 2.39 respectively, for urban and rural population.

The phenomena of urbanization in Costa Rica will be treated in a more detailed manner in Chapter IV. In Chapter V, the effect of urban expansion upon agriculture in the San José Metropolitan Area will be explained. The remainder of the present chapter examines the effect of urbanization upon food consumption and production in the country as a whole.

Table 5. Average annual compound growth rates of total, urban and rural populations, Costa Rica, 1950 to 1973

Area	1950-1963	1963-1973
	----------percent---------	
Urban	4.16	5.01
Rural	3.83	2.39
Total	3.94	3.37

Source: Table 4

Changes in Sectorial Employment and Production Patterns

Concurrent with the urbanization of Costa Rica have been shifts in the employment of labor and in the location of economic activity. These shifts are reflected in the growing proportion of the labor force engaged in non-agricultural employment, and increases in both absolute and per capita Gross Domestic Product (GDP), but a decrease in the proportion of GDP produced in agriculture. As urbanization has increased, so has the functional specialization and interdependence of the city and the farm. Correlated with the growth of urban areas has been a higher level of commercialization of the primary sector, as markets develop for the use of agricultural products in manufacturing, industry and food processing in the secondary sector, and a concommitant expansion has occurred in the tertiary sector for transport, farm and urban services. The result of this development has been greater and more diversified commercial cross flows among economic sectors of foodstuffs for households, specialized labor for farm production, improved productive inputs -- such as chemicals and improved seed varieties, and animal stock -- and investments in capital goods. With the rise in income from increased economic activity, food consumption patterns have been altered, especially for the growing urban populations. Demands for higher-protein and more desirable foods have increased, especially for meat, dairy products, fruits and vegetables [Wibberly, 1959, pp. 70-71]. In this section, the changes in labor location and sectorial employment patterns and their effect upon the national economy will be measured. The subsequent effects upon consumption patterns and the reacrions of farmers to food demand, as reflected in their use of the land resource, are described in subsequent sections.

According to census data, Costa Rica is predominantly a rural nation. Between 1950 and 1963, the urban component comprised slightly more than a third of the total population; by 1973 this figure had risen to above 40 percent. Yet the proportion of workers involved in the primary sector declined substantially from over half (54.7 percent) in 1950 to approximately one in three (36.4 percent) in 1973 (Table 6).

The once dominant relative share of the Costa Rican labor force has shifted from the primary sector into the more urban-oriented occupations of the secondary sector, especially manufacturing and construction (in Costa Rica, these industries are relatively labor-intensive) and notably into urban-based services such as the energy and transportation industries, commercial employment, and the public sector.

This apparent discrepancy in a rural-populated nation, two-thirds of whose population consists of workers in urban-based employment can be explained in definitional terms and with the knowledge of the historical geography of Costa Rica presented in the preceding chapter. Frank Bachmura, in his study of the linkages between urbanization and land reform, addressed the first point of this urban-rural dichotomy:

> The two sectors [urban and rural] are bound together economically by transfers of goods and services on both the input and output levels. Even in geographic terms, the boundary between rural and urban sectors is not fixed in a temporal sense nor is it always precisely determinable [Bachmura, 1970, p. 1].

Table 6. Economically Active Population (PEA) and percentage share of labor force by economic sector, Costa Rica, 1950, 1963 and 1973

Sector	1950		1963		1973	
	-number-	--percent-	-number-	--percent-	-number-	--percent-
Primary (a)	148,837	54.7	194,309	49.2	213,226	36.4
Secondary (b)	42,249	15.5	69,763	17.6	110,552	18.9
Tertiary (c)	80,898	29.8	131,201	33.2	261,535	44.7
Total	271,984	100.0	395,273	100.0	585,313	100.0

a/ Includes agricultural, livestock and fishing industries.
b/ Includes manufacturing, mining, construction and related activities.
c/ Includes commerce, transportation, energy, and governmental services.

Sources: Costa Rican Population Census, 1950, 1963 and 1973

This generalized statement on the problem of urban-rural determination received more specific critical commentary in a recent study at the National University [see Govaere, 1974, pp. 3-6].

With reference to the second explanation, the historical settlement since the colonial era has traditionally been concentrated in the Central Plateau. This concentration originated in fertile rural zones with relatively high demographic densities, located around the central market of San José and the cities of Alajuela, Heredia and Cartago. During the modern era, these zones have been transformed from agricultural use into residences for inhabitants with urban occupations. As persons occupied in the primary sector within these contiguous zones have sought employment in the secondary and tertiary sectors in nearby cities, there have been concurrent migrations from the central urbanized zones. While residential areas have been displaced by commercial and governmental services, these areas in the process of urbanization have remained rurally classified. It is this currently "suburbanizing" that has registered extraordinary growth [Zumbado and Neuhauser, 1977, p. 75] and caused the discrepancy in urban-rural distinctions. Those cantons under the most intense pressures of suburbanization -- Escazú, Desamparados, Alajuelita and Curridabat -- have been the locations of the greatest absolute percentage decline in the labor force engaged in the primary sector (Table 7). As might be expected, the proportion of the economically active persons within the Metropolitan Area is now low and steadily decreasing.

Both the phenomena of rural-to-urban migration and the fact that only 3.02 percent of the population in the Metropolitan Area is currently engaged in agriculture while 16.1 percent is still classified

Table 7. Percentage of the Economically Active Population (PEA) engaged in agriculture in the San José Metropolitan Area, 1963 and 1973

Canton	1963	1973	Percentage Change 1963-1973
Central	3.71	1.39	-48.84
Escazú	32.83	12.60	-27.23
Desamparados	14.42	3.44	-26.79
Goicoechea	6.62	2.64	-39.01
Alajuelita	16.03	4.68	- 8.71
Tibás	6.08	2.24	-38.88
Moravia	9.91	2.86	-46.35
Montes de Oca	7.65	3.10	-35.52
Curridabat	22.96	7.37	-41.78
Metropolitan Area	7.36	3.06	-32.91

Source: Office of Metropolitan Area Planning (OPAM) and University of Florida as rural, can be at least partially explained in economic terms. An analysis of heads of migrant households in 1963 concluded the following:

> Perhaps the most important and obvious economic benefit to be derived from migration is an increase in the migrant's level of income. A comparison of the wages and salaries earned by the sample of household heads reveals that recent migrants earn significantly higher income than do settled migrants, and settled migrants earn significantly higher incomes than do non-migrants [Carvajal and Geithman, 1974, pp. 108-109].

Of the main categories of occupations within the three sectors of the Costa Rican economy, the lowest average monthly income for salaried laborers is registered for agriculture (Table 8). Two-thirds of workers in the primary sector earn less than ₡400 per month with an average monthly income of ₡395 ($46.23). In ascending order, workers in the construction industry earn, on the average, one and a half times more than those in agriculture; industrial laborers, two-thirds more; commerce, 80 percent greater earnings; transport workers twice the wage rate; and those in the service industry, nearly three times the monthly salary received by farm laborers. These significant differences in income earnings among urban and rural occupations undoubtedly act as a strong inducement for shifts in employment patterns and migratory flows toward urban centers.

Parallel to the pattern of urbanization, and the shift of population from the primary sector into more urban-based employment, has been a substantial decline in agriculture's contributive share to the Gross Domestic Product. The primary sector's share of the GDP has declined from 38.3 percent in 1950 to less than one-fifth in 1973 (Table 9). While the deflated GDP has increased geometrically at a rate of 6.92 percent annually, the annual compounding growth rate of

Table 8. Average monthly salary in *colones* (¢/mo.) and distributional percentage of wage-earners by occupation, Costa Rica, 1973

Occupation	Average salary	Percentage less than ¢400/mo.	Percentage between ¢400-999/mo.	Percentage greater than ¢1,000/mo.
	¢/month	------------------	percentage	------------------
Agriculture	394.80	67.7	28.7	3.6
Industry	666.50	34.9	46.6	18.5
Construction	583.60	39.8	49.4	10.8
Commerce	716.80	35.5	47.6	16.9
Transportation	812.10	23.4	49.6	27.0
Services	1,094.00	11.5	47.4	41.1

Source: *Costa Rican Population Census*, 1973

Table 9. Estimates of Gross Domestic Product (GDP) and percentage distribution by economic sector, Costa Rica, 1950, 1963 and 1973

Sector	1950	1963	1973	1950	1963	1973
	millions of ---constant colones-----			-----percent------		
Primary (a)	578.3	976.5	1,395.1	38.3	28.3	18.8
Secondary (b)	251.5	650.4	1,813.5	16.7	18.8	24.5
Tertiary (c)	678.3	1,826.1	4,202.1	45.0	52.9	56.7
Total	1,508.3	3,452.1	7,410.7	100.0	100.0	100.0

a/ Includes agricultural, livestock and fishing industries.
b/ Includes manufacturing, mining, construction and related activities.
c/ Includes commerce, transportation, energy and governmental services.

Sources: Central Bank of Costa Rica.

Table 10. Productivity of Economically Active Population (PEA) in labor force and average annual compound growth, by economic sector, Costa Rica, 1950 to 1973

Sector	1950	1963	1973	1950-63	1963-73	1950-73
	----hundred colones---			------------percent------------		
Primary	38.9	50.3	65.4	1.98	2.64	2.27
Secondary	59.5	93.2	164.0	3.45	5.65	4.41
Tertiary	83.8	139.2	160.7	3.90	1.44	2.83
Total	55.5	87.3	126.6	3.49	3.71	3.59

Sources: Central Bank of Costa Rica and Costa Rican Census Bureau the primary sector has been a much lower figure of 3.82 percent. During the 23 year period (1950-1973), the total GDP increased five-fold, while agriculture increased only half as much. Tremendous growth was realized in both the secondary and tertiary sectors, which increased by multiples of six to seven times during the same period.

This reduction in the relative share of agriculture in the total economic activity is due not only to the loss of workers to the other sectors, but also to the differences in productivity of the workers within each sector. A gross measure of productivity, the amount of GDP per capita, reveals that the average Costa Rican worker produced ₡5,456 ($639) worth of the nation's annual productive income in 1950 and that this measure grew in constant terms to ₡12,661 ($1,483) by 1973 (Table 10). While productivity grew by 2.97 percent annually in the primary sector, this was well below the national average of 4.47 percent per year. Presently, the productivity of workers in secondary and tertiary industries is two and a half times greater than the productivity of those employed in agriculture.

Export Crops

Agricultural products have traditionally supplied Costa Rica with a large proportion of its national income. Until recently, the "dessert products" of coffee, bananas, and cocoa have been the almost exclusive sources of foreign exchange earnings. This dependency upon a few products, whose export markets are limited primarily to the United States and West Germany, has prompted the public sector to consider development programs to diversify the Costa Rican economy.

Tables 11 and 12 detail the value of principle exports and their respective percentage shares in selected years from 1950 to 1973. Export earnings of agricultural products have increased five-fold in this interim, from $54.1 million to $257.5 million. Industrial exports, which were insignificant years ago, now account for a quarter of the total export value, primarily due to increased trade with members of the Central American Common Market. Coffee and bananas, which in 1950 accounted for 91.1 percent of total export earnings, have climbed in value but their combined export share has declined to 53.6 percent. Cocoa trade, once the third most important export crop, has stagnated, while meat and sugar exports have increased dramatically with increased demand from markets in the United States.

Costa Rica possesses comparative advantages with respect to other banana exporting countries: a natural resource base conducive to growing superior quality fruit; and geographical proximity to the principle importing nation, the United States. Production declined between 1952 and 1961, but increased when an independent, national banana company was created to compete with the two foreign companies--United and Standard Fruit Companies. National producers increased their control of banana production to two-fifths of the total banana production by the early 1970s and production increases accounted for 40 percent of the expansion in agricultural export earnings in the last decade [OFIPLAN, 1973, pp. 19-20].

Coffee production was stimulated during the 1950s by relatively high prices, which by 1957 had reached $1.35 per kilogram. Continuous price declines, which in 1963 fell to $0.83 per kilogram, dampened coffee sales and export earnings. This stagnation in coffee production

Table 11. Value of principal exports, Costa Rica, 1950 to 1973, selected years

	1950	1955	1963	1967	1973
	--------------------	--------------------	million dollars[a]	--------------------	--------------------
Agricultural					
Coffee	17.8	37.4	45.3	54.8	94.0
Bananas	31.5	33.2	25.8	30.9	90.7
Meat	-	1.0	5.7	9.2	31.5
Sugar	-	-	5.1	8.4	21.5
Cocoa	2.0	5.9	4.3	3.1	4.4
Other	2.8	3.4	8.2	5.0	15.4
Subtotal	54.1	80.9	94.4	111.3	257.5
Industry	-	-	0.6	32.5	87.0
Total	54.1	80.9	95.0	143.8	344.5

a/ 1 U.S. dollar = 8.54 CR colones.

Sources: Costa Rican Census Bureau and Central Bank

Table 12. Percentage distribution of value of principal exports, Costa Rica, 1950 to 1973, selected years

Commodity	1950	1955	1963	1967	1973
	percent of total				
Coffee	32.9	42.2	47.7	38.1	27.3
Bananas	58.2	41.0	27.2	21.5	26.3
Meat	-	1.2	6.0	6.4	9.1
Sugar	-	0.1	5.4	5.8	6.2
Cocoa	3.7	7.3	4.5	2.1	1.3
Other	5.2	4.2	8.6	3.5	4.5
Industry	-	-	0.6	22.6	25.3
Total	100.0	100.0	100.0	100.0	100.0

Source: Table 11

was aggravated further by price stabilization programs and ash outfall onto the plantation lands surrounding Irazú volcano [OFIPLAN, 1973, p. 8]. Production began to expand in 1966 and by 1969 an upward price trend had begun. Both prices and production have continued to rise.

Whereas norms for coffee production and exportation are bound by stipulations under the International Coffee Agreement, cocoa is not restricted by international trade arrangements, but rather is subject to variations in the world market. Under conditions of depressed prices and increases in competition from other producing nations, cocoa has declined both in absolute and relative export value. In 1950 it was the third most important export crop. By 1963 earnings from cocoa export had been surpassed by meat and sugar products, and in 1973, the $4.4 million derived from its export accounted for only 1.3 percent of total export earnings.

Beef and sugar exports were of little significance until the late 1950s, after which they experienced significant expansions. Spurred by both increasing domestic and international demands and by favorable prices, these commodities now account for over 15 percent of Costa Rican's value of exports. Sugar trade assumed more importance when diplomatic problems developed between the United States and Cuba in the late 1950s. With the consequent expansion of U.S. import quotas, sugar exports rose substantially and now are valued at $21.5 million. Export quotas are set by the National Production Council (CNP) to stabilize internal prices of beef and livestock products. Beef production gained importance under a program of economic diversification, in which teams from the University of Florida participated. Inducements for beef export were strengthened during the 1958-1963 period when prices rose from $0.41 to $0.71 per kilogram. In 1963 over 7 million kilograms of meat valued at $5 million were exported, together with livestock which added another $0.7 million to export earnings [MAG-OFIPLAN, 1965, p. 20]. With increased international demand, primarily from the United States, value of beef exports climbed to $31.5 million by 1973.

Exports of industrial products, which depend primarily upon inputs from the primary sector or represent surpluses of domestic production of inputs for the primary sector, increased substantially in the past decade. Insecticides were the first Costa Rican industrial export, valued at $3.48 million in 1957. During the 1960-1965 period, 25.2 percent of industrial investments from the National Banking System were funneled into insecticide and fertilizer plants at the port of Puntarenas. In this same period, 55.9 percent of industrial capital investment was earmarked for plants which utilized inputs from the primary sector. This type of industrial production includes in order of economic importance: food, drink and tobacco processing; paper, rubber and leather products; and textile, clothing, wood and furniture industries. With the incorporation of Costa Rica into the Central American Common Market in 1963, these industries began to play an important role in generating export earnings and providing employment for local urban workers.

Changes in Consumption

This section describes and analyzes consumption and internal demand characteristics for Costa Rica during the 1950 to 1973 period.

An understanding of consumption patterns is important not only in explaining and predicting economic behavior, but also has applied ramifications in the area of political economy--such as evidenced in price stabilization and support systems employed by the National Production Council (CNP) and credit features of the National Banking System (SBN). Patterns presented here, especially differences between urban and rural consumption, will provide insights into the subsequent analysis of differential land use patterns surrounding the San José Metropolitan Area.

Consumption has been viewed theoretically as a function of economic variables such as price and income, as well as cultural and social factors including tastes and preferences, geographic location, family size and composition, sex, race and occupational status. Empirical studies have shown that as per capita income rises or falls, there is generally a change in consumption patterns. The consumption of food products in developed countries tends to grow proportionally less than income, although there exists an extensive variation among changes in expenditure for specific food products.

The Costa Rican Census Bureau (DGEC) has conducted a series of indepth studies of consumption at the household level among middle- and low-income residents of the San José Metropolitan Area. A summary of these findings for the years 1949 and 1961 is presented in Table 13. These data provide indications of the changes in consumption that occurred between 1949 and 1961. Family expenditures for food products grew slightly from 44.7 to 45.2 percent. The proportions of expenditures for cereals, vegetables, drinks, sweetners, and condiments declined; increases were registered for meats and animal products--

Table 13. Percentage distribution of family expenditures on goods and services, San José Metropolitan Area, 1949 and 1961

Item	1949	1961
	------percentages-------	
Food Items		
Cereals	10.94	9.64
Vegetables	7.63	7.48
Fresh meat	6.17	8.18
Animal products	8.21	9.80
Fruits	1.16	1.96
Sweetners	3.76	2.81
Drinks	3.70	2.53
Oils	2.19	2.17
Condiments	0.89	0.66
Subtotal	44.65	45.23
Housing	17.34	21.79
Clothing	17.99	14.19
Miscellaneous	20.02	18.79
Total	100.0	100.0

Source: Costa Rican Census Bureau, 1965, pp. 12-16 including beef, pork, chicken, fresh milk, butter, cheese and eggs--and for fruits. Housing expenditures and associated costs increased in such areas as rent, furniture and appliances. Concurrent percentage decreases in expenditures occurred in the clothing and miscellaneous categories. Although a similar study was conducted in 1974 by the DGEC for the Costa Rican Central Bank (BCCR), these results have not been published.

Trends in the consumption of typical food commodities in Costa Rica can be noted in Table 14. Figures for 1950 were estimated by calculating net commodity availability (national production less exports plus imports) standardized on a per capita basis. The National Planning Office (OFIPLAN) calculated in a similar manner the 1963 figures; while data for 1971 represent results of a cross-sectional household sample survey conducted among 3,100 families in Costa Rica [Cespades, 1971, pp. 4-6]. Percentage compositions of average annual per capita consumption for 1950 and 1963, classified by carbohydrates, proteins, fats and oils, appear in Table 15.

Per capita basic grain consumption increased by 1.9 percent annually. The major increases were registered in bean and rice consumption, complementary ingredients of the typical Costa Rican dish, "gallo pinto", while corn consumption declined. The intake of other major carbohydrates such as bananas and plantains, reveals a slight cross substitution during 1950-1963. Meat and animal product consumption increased substantially in the past two decades even though beef and pork prices increased 1.9 times faster than the price index for all foods. The average Costa Rican has increased the consumption of meats from 40.2 to 62.0 pounds per year, which represents a 54.6

Table 14. Average annual per capita consumption, selected commodities, 1950, 1963 and 1971, Costa Rica

Commodities	1950	1963	1971
	-----in pounds per capita-------		
Rice	48.3	63.7	105.0
Corn	91.9	52.3	60.0
Beans	16.8	21.8	57.0
Banana	27.8	24.7	(a)
Plantain	45.9	49.0	(a)
Beef	35.3	29.5	48.0
Pork	4.6	3.3	6.0
Chicken	0.2	1.9	8.0
Milk products	140.0	148.2	247.7
Eggs	(a)	(a)	27.4
Sugars	183.5	165.8	(a)
Coffee	7.1	4.4	(a)
Chocolate	1.5	0.9	(a)
Fats and oils	9.9	12.6	(a)

a/ Data not available.

Sources: OFIPLAN - MAG, 1965, p. 41;
Cespedes, 1973, p. 120

Table 15. Consumption of food commodity types by percentage of total gram intake in Costa Rica, 1950 and 1963

Commodity	1950	1963
	------- percentage--------	
Carbohydrates	72	63
Protein	27	35
Fats and Oils	1	2
Total	100	100

Sources: OFIPLAN, 1965, pp. 33-37

percent growth for these protein sources. High beef prices in 1962, which rose 26 percent due to high export and domestic demand, dampened beef consumption and caused cross-substitution with other protein-rich commodities [OFIPLAN-MAG, 1965, p. 47]. The effective demand for protein substances in also evidenced in the large increase in consumption of milk products by Costa Ricans, which has grown at an average annual rate of 3.7 percent.

Several general interpretations can be made concerning food consumption characteristics of Costa Ricans in the last 21 years. First, the total expenditures for food and the percentage of income spent on food appear to have risen with time and income. These facts indicate that Costa Rica as a whole has been in the stage of development in which food is considered a superior rather than an inferior good with respect to non-food goods. As effective demand has grown, Costa Ricans have tended to spend proportionally more of their incomes on meat and animal products as opposed to carbohydrates; this is a sign of a developing economy.

These changes in consumption patterns have been induced, in part, by increasing urbanization. The food intake characteristics of urban dwellers differ markedly from those of rural inhabitants. Urban residents consume on the average less than three-quarters the amount of basic grains than the rural populace: rice consumption varies little but marked differences occur for bean and corn products (Table 16). Rural inhabitants consume 30 percent more beans and almost three times as much corn as urban residents.

Substantial differences in consumption appear for meat and animal products among urban and rural residents. Consolidation of the meat

Table 16. Annual per capita consumption of selected commodities, urban and rural zones in Costa Rica

Commodity	Units	San José Metro	Other Urban	Rural
Rice	lb.	102	108	106
Beans	lb.	48	52	63
Corn	lb.	29	34	79
Beef	lb.	71	69	33
Pork	lb.	10	11	3
Chicken	lb.	11	10	6
Fish	lb.	13	12	6
Milk	liter	171	150	119
Eggs	each	226	215	147

Source: Cespedes, p. 69, 1973

group reveals that residents of the Metroplitan Area and other urban areas consume 105 and 102 pounds of meat annually, over twice the amount (48 pounds) consumed by rural residents per year. Considered separately, twice the amount of the meat products of beef, chicken and fish were consumed by urban dwellers, and pork consumption was three times as great as rural intake. Cespedes [1973, p. 100] found that over a fifth of rural residents did not consume any beef, as opposed to only a 5 percent figure for residents of urban zones. Of the animal products considered, people in urban zones consumed between 26 and 44 percent more fresh milk, and one and a half times more eggs than those in rural zones.

While some of these differences may be attributed to cultural and social preferences, the main determinant appears to be economic. From survey data, Cespedes [1973, p. 51] has estimated that urban residents earn average monthly incomes of ₡1,703 ($199) while rural residents, earn only ₡796 ($93) per month. Urban zones with over twice as much per capita income as rural zones can be expected to have a correspondingly higher effective demand for food products; this higher income is reflected in consumption of better and more protein-rich commodities.

Summary survey data for average annual per capita consumption of basic grains, meats and animal products are plotted against average monthly per capita income in colones in Figures 6 through 8 [Cespedes, 1973, p. 77]. The relationship between consumption and income for beans and rice are asymptotic and declining; the consumption of rice declined faster, compared with beans, with respect to changes in income.

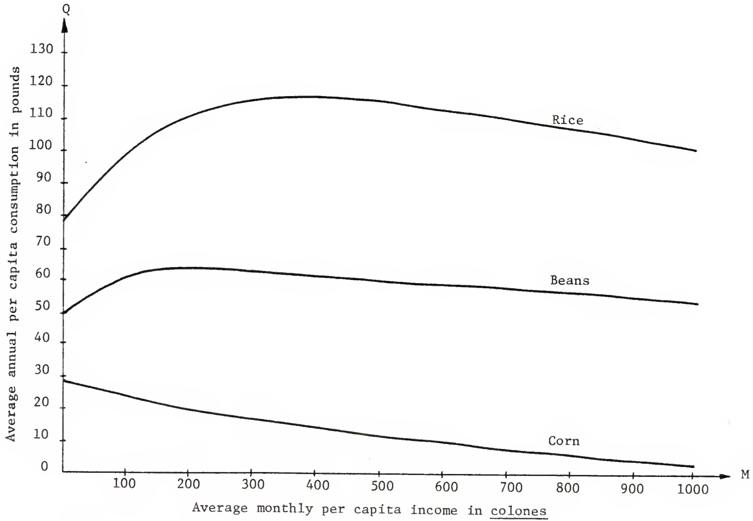

Figure 6. Income-consumption relationship for principal basic grains, Costa Rica, 1971

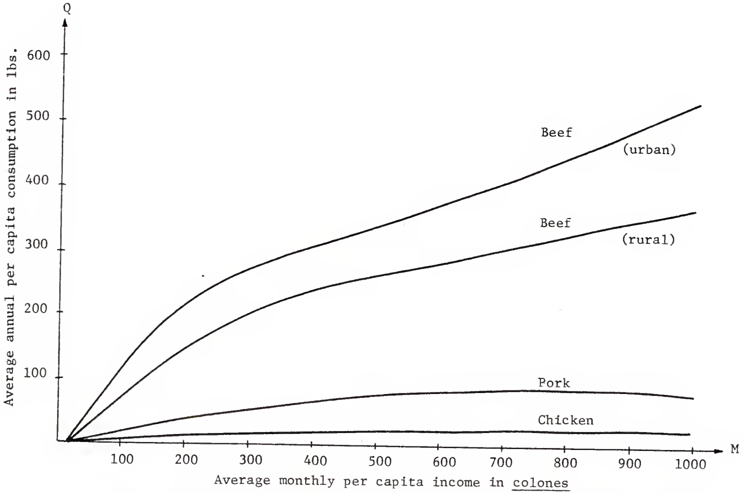

Figure 7. Income-consumption relationship for selected meats, Costa Rica, 1971.

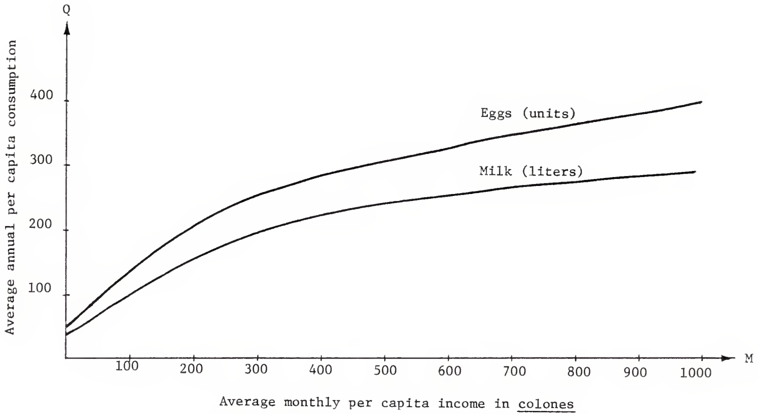

Figure 8. Income-consumption relationship for selected animal products, Costa Rica, 1971

Corn consumption experienced a steady linear decline with increases in income. Beef consumption for both urban and rural areas revealed a rapid rise at lower income levels that continued to increase but at a decreased rate throughout the middle- and higher-income groups. The trends for pork and chicken consumption also increased with income, although pork consumption declined in the higher range of incomes, while chicken consumption continued to increase. Fresh milk and eggs reveal income-consumption patterns similar to those for meats.

Engel curves, income elasticities (N_i) and marginal propensities to consume (MPC) were estimated for these products with supplementary data from the Latin American Data Bank (LADB). The results appear in Table 17. Income elasticity coefficients and marginal propensities to consume for basic grains are low or negative, milk and eggs possess middle range values, and meat products have relatively high values. Beans and corn can be definitely considered as inferior goods as they reveal decreased expenditures with increases in income. Milk and eggs have similar income elasticity coefficients, 0.54 and 0.59, respectively, although the marginal propensity to consume for milk is higher than for eggs for the average Costa Rican income. Income elasticities for meats range between 0.78 and 1.07, coefficients that reveal normal to superior goods. The highest marginal propensity to consume is for beef, representing a *céntimo* (100 céntimos = 1 colón) increase in expenditure for each additional *colon* of income for the average Costa Rican consumer.

Table 17. Income elasticities of demand (N) and marginal propensities to consume (MPC) for selected commodities, Costa Rica

Commodity	Units	MPC	N_i	Functional form	R^2
Beans	lbs.	-.0002	-0.32	log-inverse	.44
Rice	lbs.	.0002	.050	log-inverse	.71
Corn	lbs.	-.0010	-.395	linear	.94
Beef	lbs.	.0098	.780	double-log	.90
Pork	lbs.	.0017	1.071	semi-log	.88
Chicken	lbs.	.0014	.784	double-log	.92
Milk	liters	.0062	.540	double-log	.94
Eggs	units	.0023	.591	double-log	.94

Source: Cespedes, 1971

Production and Productivity Indicators

The trends in export crops, internal demand for food and the availability of agricultural land discussed above together with food price increases, provide a basis for the following evaluation of production response by Costa Rican farmers. This section traces the changes in quantity produced, area under production and yields for total agricultural and food production during 1950 to 1973 and for major crops in Costa Rica for the census years, 1955, 1963 and 1973. As the stock of additional arable land, which in the past has served to expand production, declined, the nation's farmers increasingly substituted other inputs for land for those crops which have displayed favorable demand characteristics. In general, this pattern of change occurred with export crops, where the tendency was to expand planted area, total production and yields. Of the three basic grains, only rice with a positive income-consumption relationship at average income levels, registered substantial gains in production indicators.

Production Indexes

Changes in the indexes of total agricultural and food output and production factor proportions for selected years are presented in Table 18 (see Appendix II). From 1950 to 1973, total agricultural and food output expanded by multiples of 2.8 and 3.1, with average annual compound rates of 4.47 and 4.89 percent, respectively. During the same period, agricultural land and labor increased at average compound rates of 2.34 and 1.56 percent, respectively. The fact that production has increased faster than the additions of land and labor is demonstrated in the summary results of regression analysis in Table 19.

Table 18. Changes in output and factor proportions in Costa Rican agriculture, 1950 to 1973, selected years

Item	Year						Average annual compound growth rates		
	1950	1955	1960	1963	1968	1973	1950-1963	1963-1973	1950-1973
	1951-1953 = 100						percent		
Total agricultural output	78	96	134	127	161	218	3.75	5.45	4.47
Total food output	87	92	156	161	199	268	4.73	5.10	4.89
Agricultural labor	95	105	117	124	130	136	2.05	0.92	1.56
Total output per worker	82	91	115	103	124	160	1.75	4.40	2.91
Food output per worker	92	88	133	130	160	197	2.66	4.16	3.31
Agricultural land	99	101	127	146	158	171	2.99	1.58	2.34
Total output per has. of agricultural land	79	95	106	87	102	127	0.07	3.78	2.06
Food output per ha. of agricultural land	88	91	123	110	126	157	1.72	3.56	2.52
Agricultural land per worker	104	96	109	118	122	126	0.97	0.66	0.83

Source: Appendix II

Food price increases are an inducement to increase production, which has increased 1.6 and 3.8 times faster than additional land and labor use. The result has been rapid increases in land and labor productivity, especially during the last decade (see Table 18). Results of the analysis of the increases in the land- and labor-saving production inputs of fertilizer and machinery that have increased the productivity of traditional inputs, are given in subsequent sections.

Table 19. Linear regression of food production index on food price index and indexes of land, labor fertilizer and horsepower, Costa Rica, 1950 to 1973

Independent variables	Estimated coefficient (standard error)	Coefficient of det. (R^2)	Standard error of estimate
Food Price	2.121(a) (0.172)	0.874	0.196
Agricultural land	1.648(a) (0.102)	0.923	0.099
Agricultural labor	3.844(a) (0.370)	0.874	0.196
Fertilizer	0.023(a) (0.002)	0.879	0.192
Horsepower	0.100(a) (0.007)	0.910	0.166

a/ Significant at 0.001 level.

Source: Appendix II

Principal Crops

Data concerning total production, area under production and yields for the years 1955, 1963 and 1973 are provided in Table 20 for principal Costa Rican crops. Yields may vary greatly from year to year, yet certain trends may be noted from these data. The expansion of land in coffee appears to have tapered off, while total coffee production has tripled in the last 18 years. Coffee has traditionally been planted in the central highlands region where the majority of the population resides. The reduction in the average annual increase in coffee lands from 5.6 percent during 1955 - 1963 to 0.2 percent in the last decade can be attributed to both the unavailability of land appropriate for coffee production and an increased competition with land for urban areas around which coffee was originally planted. The result of these factors has been to raise productivity on existing coffee lands. Table 20 demonstrates that yields have almost doubled in the last two decades. The phenomena are presented in more detail in subsequent chapters.

Banana production, which is concentrated in coastal, lowland plains, experienced a boom in the last decade. Production tripled from 1,328 to 3,628 thousand bunches from 1955 to 1973, while the producing area increased by 50 percent. The result was a three-fourths growth in yields per hectare. This substantial expansion has been due in part to new varieties introduced by foreign-based companies -- Valery and Giant Cavendish -- that are resistant to Panama disease, which plagued the traditional Gros Michael banana [Blutstein, 1970, pp. 232-233]. National producers have also shared in this growth with investment funds provided by the government.

Table 20. Total production, area in production and yields of principal crops, Costa Rica, 1955, 1963, and 1973

Crop	Units	1955	1963	1973
Coffee	1000 Metric tons	132.8	268.4	369.2
	Hectares	56,345	81,383	83,407
	Metric tons/ha.	2.4	3.3	4.4
Banana	1000 bunches	1,328.0	1,340.0	3,628.0
	Hectares	23,476	25,558	36,155
	Bunches/ha.	563.9	524.1	920.5
Sugar Cane	1000 Metric tons	587.1	1,068.5	2,246.1
	Hectare	19,256	25,283	38,763
	Tons/ha.	30.5	42.3	57.9
Cocoa	1000 Hundred wt.	129.7	343.1	100.0
	Hectares	19,692	37,881	20,305
	Hundred wt./ha.	6.6	9.1	4.9
Tobacco	Hundred wt.	15.6	28.7	35.4
	Hectares	1,060	1,451	1,506
	Hundred wt./ha.	14.8	19.8	23.5
Cotton	Hundred wt.	2,943.0	44,478.0	3,865.0
	Hectares	438	3,176	74
	Hundred wt./ha.	6.7	14.0	52.6
Rice	1000 Hundred wt.	378.6	868.1	2,261.1
	Hectares	23,341	50,506	65,458
	Hundred wt./ha.	14.9	17.2	34.5
Beans	1000 Hundred wt.	234.5	347.0	233.2
	Hectares	33,442	43,830	26,681
	Hundred wt./ha.	7.0	7.9	8.7
Corn	1000 Hundred wt.	1,017.6	1,215.1	1,140.1
	Hectares	49,976	53,076	51,888
	Hundred wt./ha.	20.4	22.9	22.0

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Sugar cane production, spurred by strong demand from the United States, has experienced a similar expansion. Total production of sugar cane has almost quadrupled during the study period, with an increase from over half a million metric tons in 1955 to two million and a quarter metric tons in 1973. Both sugar cane area and yields have doubled during the same period. Statistics for cocoa are quite different. Although there were significant increases in these production indicators from 1955 to 1963, lagging export demand forced a drop in production during the 1970s to a point less than a third of its former level, while the area under production and productivity were reduced by 54 percent. Tobacco, another traditional crop, experienced a steady 3.25 percent growth rate in yield. Cotton production, one of the foci of diversification programs in the 1960s, experienced a phenomenal expansion until 1963 when Costa Rica joined the Central American Common Market. Costa Rica now imports most of its cotton from Nicaragua, El Salvador and Guatemala. Only a few, highly productive cotton operations existed in 1973.

The production response among basic grains reflects the consumption characteristics outlined in the preceding section. Rice, the only cereal among the three staples analyzed that has a positive income elasticity coefficient and marginal propensity to consume among Costa Ricans, has shown substantial gains in production indicators. This expansion, in part due to an incipient export trade that amounted to ₡1.2 million ($0.14 million) in 1973, witnessed between 1955 and 1973 a threefold increase in production area and six times as much quantity produced. Land productivity, supplemented by use of modern inputs of fertilizers and herbicides has increased from 14.9 to 34.5 hundredweight during this period. Although bean yields experienced some growth, from 7.0 to 8.7 hundredweight per hectare in the 1955 to 1973 period, total production declined almost 50 percent in the last decade, with only 60.8 percent of the 1963 area planted in 1973. Thus, producers have responded rationally, as per capita bean consumption declines with increases in per capita income. Even though corn has the most disfavorable income elasticity and marginal propensity to consume coefficients of the major basic grains, production has stabilized. This is influenced by the fact that over a third of the corn crop is used for on-farm animal and poultry feed, products which have strong demand characteristics. Given the increased demand for meats, corn production has remained relatively stable with respect to production indicators; decreased demand for direct human consumption has been compensated by increased demand for stock feed.

Production Inputs and Development

Total food production may be increased in several ways. An increase can be a simple function of an expansion of cultivated area using traditional technologies and factor proportions. Growth may also stem from development of the food production system with the application of industrially produced capital production inputs and modern production practices which increase yields on existing areas of agricultural land under production. This later development may involve several conditions: an increase in labor efficiency with the use of capital goods and supplementary energy sources; an increase in soil fertility with the application of organic and chemical fertilizers; a decrease in crop losses due to pests and diseases with insecticides, fungicides and herbicides; improvements in the genetic characteristics of seed and animal stock; and the use of modern cultural practices and techniques that foster and complement these factors.

In this section trends in the use of traditional land and labor production inputs and trends in the use of modern production inputs, especially fertilizers and energy sources, are presented. These data indicate that the growth in total agricultural production and total food production, described in the previous section, resulted from the use of modern production inputs from the industrial sector to ease the constraints of inelastic supplies of agricultural land and labor. The hypothesis that this development in agricultural production has been induced by changes in relative factor prices is then tested.

Traditional Production Inputs

The use of traditional land and labor resources and their respective prices for selected years from 1950 to 1973 are given in Table 21. Total agricultural land has increased at an average compound rate of 2.37 percent annually, but the rate of land expansion was higher in 1950 to 1963 than in the decade from 1963 to 1973. The area of arable and permanent crop land increased at a compound annual rate of 4.72 percent from 1950 to 1963 and subsequently declined. The large difference between total agricultural land and the area in arable and permanent crops is due to extensive forests and pastures on Costa Rican farms. Average land values during the 1950 to 1973 period have increased at an increasing rate in current and constant terms. From

Table 21. Agricultural land and labor resources, prices and price indexes, and average annual compound rates of change, Costa Rica, 1950 to 1973, selected years

Item	Units	1950	1955	1960	1963	1968	1973	1950-1963	1963-1973
								-------percent------	
A) Total agricultural land	1,000 ha.	1,811	1,852	2,327	2,668	2,886	3,123	2.98	1.57
B) Arable and permanent crop land	1,000 ha.	299	309	461	532	521	490	4.72	-1.19
C) Agricultural workers	1,000	149	165	183	194	204	213	2.03	0.93
D) Total land per worker (A/C)	ha./worker	12.2	11.2	12.7	13.8	14.1	14.7	0.95	0.63
E) Arable and permanent cropland per worker (A/C)	ha./worker	2.0	1.9	2.5	2.8	2.6	2.3	2.59	-1.97
F) Average land value	current ₡/ha.	75	114	143	168	208	374	6.20	8.01
G) Average land value index(a)	1952 = 100	91	124	145	156	179	242	4.15	4.39
H) Farm wage rate	current ₡/day	3.00	4.15	5.50	6.86	9.18	15.17	6.36	7.94
I) Farm wage index(a)	1952 = 100	91	114	141	161	199	247	4.39	4.30

a/ Adjusted with General Price Index.

Source: Appendix II

1950 to 1963 average land price per hectare in current colones increased from ¢75 to ¢168, representing a 6.2 percent average annual compound rate of increase. In 1973, land was valued at an average of ¢374, having increased at an annual average rate of 8.0 percent. In constant terms, the average price of land increased at an average compound rate of 4.25 percent during the 1950 to 1973 period.

Agricultural labor force has grown at a slower rate than total agricultural land and population. The result of this differential growth has been an increase in the number of farm hectares per worker from 12.2 in 1950 to 14.7 in 1973 and an increase in total population per worker from 5.4 in 1950 to 8.8 in 1973. The average number of hectares of arable and permanent farm land per worker has decreased since 1963. The divergent trends in total farm and arable and permanent crop land reflect the increased importance of land-extensive cattle enterprises (see Table 1). While the number of farm workers employed in the farm sector has increased at a decreasing rate, average farm wages have accelerated in terms of current colones and demonstrate a strong upward trend in terms of constant colones.

Several generalizations can be made concerning traditional land and labor inputs during the 1950 to 1973 period. Increases in land values, which have paralleled population increases, urbanization and closure of agricultural frontier, have led to a diminished rate of additional total farm area and an absolute decrease in the area of arable and permanent crop lands. Rapidly rising farm wage rates, which may be associated with a general increase in the country's average per capita income and substantial social welfare programs, have led to a decreasing rate of growth in the number of farm workers.

As presented in the preceding section, both land and labor productivities have increased during the same period. In the next section, results of the analysis of the increased use of modern industrial inputs, which have contributed to the growth in productivity of traditional production factors, are presented.

Modern Production Inputs

Major variations in land and labor productivities among nations are due to differences in the levels of industrial input use [Hayami and Ruttan, 1971, p. 174]. This use of modern inputs to counteract the constraints of inelastic supplies of land and labor has prompted rapid increases in agricultural production and productivity in Costa Rica. In this section data are provided to indicate the extent of increase in land- and labor-saving inputs. Then, in the next section, the hypothesis that the process of factor substitution has been induced by changes in relative factor prices is tested.

Fertilizer input

The quantity of fertilizer and power inputs (combined animal and tractor horsepower), their respective prices and adjusted price indexes, and rates of growth are presented in Table 22 for selected years during the 1950 to 1973 period. Both the total quantity and the quantity of fertilizer per hectare have increased dramatically. This trend is particularly pronounced since 1963, when the national fertilizer company, FERTICA, was established in Puntarenas. Since 1963 fertilizer use has increased at an average annual compound rate of 22.7 percent. Current prices and constant price index data for

Table 22. Fertilizer and power inputs for agriculture, prices and price indexes, and average annual compound rates of change, Costa Rica, 1950 to 1973, selected years

Item	Units	1950	1955	1960	1963	1968	1973	1950-1963	1963-1973
								--------percent------	
Quantity of fertilizer	1,000 metric tons	8.5	24.2	57.8	64.8	306.0	629.0	15.6	22.7
Quantity of power	1,000 horsepower	9.4	15.8	37.8	57.5	114.7	228.7	13.9	13.8
Fertilizer per area	kilograms per ha.	4.7	13.1	24.8	24.3	106.0	201.4	12.6	21.2
Power per area	HP/hectare	0.05	0.09	0.16	0.22	0.40	0.73	11.4	12.0
Power per worker	HP/worker	0.06	0.10	0.21	0.30	0.56	1.07	12.4	12.7
Fertilizer price	₡ current/K	3.94	3.75	3.16	2.93	2.18	2.64	-2.3	-1.0
Fertilizer price index(a)	1952 = 100	105	90	71	60	41	38	-4.3	-4.6
Tractor price(b)	₡ 1,000 current	(c)	48.6(d)	56.5	59.2	58.8	77.8	2.8(e)	2.7
Machinery price index(a)	1952 = 100	(c)	119(d)	130	125	115	114	0.7(e)	-0.9

a/ Adjusted with General Price Index.
b/ For average tractor size of 4,445 kilograms.
c/ Data not available.
d/ 1956 data.
e/ 1956 to 1963.

Source: Appendix II

fertilizer during the 1950-1973 period reveal a substantial decline in absolute and relative fertilizer prices. Thus, one of the principal responses of Costa Rican farmers to an increasingly more expensive and inelastic land supply, together with increased food demand, has been the increased use of fertilizers.

Data in Table 23 show the increase in the percentage of total farm area by land use categories, on which fertilizer was used. The fertilized area of annual crops, primarily for domestic consumption, increased five-fold from 5.9 percent in 1955 to 30.7 percent in 1973. Fertilizer use on permanent crop area, which provide Costa Rica's major export commodities, more than doubled, from 32.3 to 70.0 percent in the same period. Although percentages for 1955 represent a somewhat different basis than those in 1973, since they exclude cocoa farm lands and the use of organic fertilizers (28.8 percent of total fertilizer for coffee in 1963 was of organic origin), these figures are indicative of the trends in fertilizer use. Growth in the amount of pasture land fertilized is significant, although by 1973 this represented only 2.6 percent of all pasture land. This level of use may be attributed to the almost exclusive use of fertilizer for intensive dairy operations in the Central Plateau, rather than for extensive beef cattle operations in other regions of the country.

While area fertilized increased during the 1955 to 1973 period, among all land use categories, the relative share of total quantity of fertilizer applied and area fertilized is dominated by export crops. This fact has been noted by McPherson [1968, p. 10] and is evidenced in Table 24. Preliminary findings show that permanent crops use

Table 23. Percentage of area fertilized by land use categories, Costa Rica, 1955, 1963 and 1973

Land Use	1955	1963	1973[a]
	percent		
Annual[b]	5.9	11.0	30.7
Permanent[c]	32.3	48.9	70.0[d]
Pasture	0.3	(e)	2.6

a/ Only chemical fertilizer; data for 1955 and 1963 includes areas treated with both chemical and organic fertilizers.
b/ Cotton, rice, potatoes and tobacco.
c/ Bananas, coffee, cocoa and sugar cane.
d/ Excludes cocoa.
e/ Not available in published data.

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Table 24. Estimated relative shares of total fertilizer application and total area fertilized by land use categories, Costa Rica, 1973

Land Use	Quantity fertilizer	Area fertilized
	percent	
Annual	14.5	26.8
Permanent	78.4	53.5
Pasture	7.1	19.7
Total	100.0	100.0

Source: Costa Rican Agricultural Census, 1973 over four-fifths of Costa Rica's fertilizer input and account for over half of the total area fertilized (see Table 25). Over a quarter of fertilized land is in annual crops, which account for 14.5 percent of the fertilizer bill. Pastures use 7.1 percent of the Costa Rican supply of fertilizer on the remaining one-fifth of the improved land areas.

While the percentage of total area fertilized among permanent crops is consistently high, the variance in the percentage of farms employing fertilizer indicates significant differences in the size of holdings. Only 3.7 percent of banana farms account for 77.7 percent of the area under production. The banana industry is characterized by a small number of large farms which produce for export and numerous small farms which produce for the domestic market. Most of the fertilizer is undoubtedly used for export production. Even though sugar cane is planted extensively throughout Costa Rica in a more evenly distributed pattern of holdings, one-quarter of sugar cane growers fertilize almost two-thirds of the total area planted. Less disparity is revealed for coffee farmers, traditionally a smallholder enterprise, in which over half of the producers apply soil nutrients.

Fertilizer rates for pastures average a quarter of the rate applied to export crops. The majority of fertilizer use for pastures is in the Central Plateau on cut hay lots of less than one hectare. Most of the country's dairy cattle are located in this region. Two-thirds of fertilizer employed in annual crop production is applied to rice and corn. Another quarter of the total fertilizer for annual

Table 25. Percentage of farms using fertilizer and area fertilized and rate, selected crops, Costa Rica, 1973

Crop	Farms using fertilizer	Area fertilized	Fertilizer rate
	-----------percent----------		--kg/ha.--
Coffee	53.0	70.2	636.5
Banana	3.7	77.7	1,299.4
Sugar cane	27.6	62.3	437.8
Pasture	(a)	2.6	188.1
Rice	20.6	62.8	217.6
Corn	44.7	20.2	172.4
Potatoes	4.2	6.5	1,502.2
Tobacco	86.2	88.8	866.5
Tomato	70.0	72.9	1,341.8
Onion	76.5	80.2	1,411.3
Lettuce	39.7	38.1	890.2
Beets	68.9	76.6	880.7
Cabbage	64.9	76.1	923.3

a/ Data not available.

Source: Costa Rican Agricultural Census, 1973 crops is applied to potatoes and tobacco, with the remainder used at relatively high rates of application on vegetables.

Power and machinery

Costa Rican farms have substantially increased the quantity of power and machinery use in production, although these inputs represent a relatively small percentage of capital use. Tractor and work stock horsepower are aggregated into a power series for the 1950 to 1975 period (see Appendix II). Data on agricultural power production inputs for selected years during the 1950 to 1973 period appear in Table 22. The estimated quantity of horsepower used in agricultural production increased from 9,405 HP in 1950 to 228,662 HP in 1973. At the current rate of average compound annual growth in power use of 13.87 percent, Costa Rican farmers are doubling power inputs every 5 years.

Similar trends were noted for horsepower per hectare of agricultural land and horsepower per agricultural worker (Table 22). Horsepower use per square kilometer increased from 5.2 HP/Km^2 in 1950 to 73.2 HP/Km^2 in 1973, doubling the ratio of power to area every 6 years. Slightly higher growth was registered for power per worker. The ratio of horsepower to each 100 workers increased from 6.3 in 1950 to 107.3 in 1973, an average annual rate of compound growth equal to 12.5 percent.

Although the trend in power use in Costa Rica has increased dramatically, the growth of supplementary machinery and electrical use has affected a small percentage of Costa Rican farms. While the proportionate use of mechanization has increased from 3 to 11 percent in the last two decades, human labor and traditional methods still exist on three-quarters of the farms (Table 26). The use of electricity related to agricultural production has more than doubled in the last decade. From these scant data it appears that there was a greater use of modern inputs in relation to other factors in the San José Metropolitan Area farms than in the rest of the country. This situation will be explained in more detail in Chapter V.

Costa Rica imports agricultural machinery from the United States, Japan and Western Europe. Due to the varying sizes of tractors imported, tractor prices and the machinery price index are standardized by average weight and cost per kilogram of equipment. Average tractor prices in current colones increased at a stable average compound rate of 2.76 percent per year from 1956 to 1973 (Table 22). The machinery price index adjusted to 1952 constant colones (see Appendix II) reveals a cyclical price pattern. Average machinery prices were 18.33 percent above the 1952 standard for the 1956 to 1973 period with a standard deviation of 7.54 percent.

Estimates for 1970 revealed that less than 2 percent of agricultural capital was represented by machinery and equipment. The use of agricultural equipment and machinery are limited by the country's irregular topography, the small size of land holdings, the nature of tillage of permanent crops, and financial constraints. This low figure for equipment and machinery capital is reflected in the statistics on the percentage of Costa Rican farms using agricultural and irrigation equipment presented in Tables 27 and 28.

Even though the number of farms using tractors increased from 502

Table 26. Percentage of farms on which selected labor and energy inputs were used, Costa Rica (CR) and the San José Metropolitan Area (SJMA), 1955, 1963 and 1973

Type of input	1955		1963		1973	
	CR	SJMA	CR	SJMA	CR	SJMA
	----------------	----------------	----------------	percent	----------------	----------------
Mechanized	3.0	4.0	9.8	17.7	11.0	(a)
Animal	14.7	12.1	18.8	14.9	12.3	(a)
Human only	82.3	83.9	71.4	67.4	76.7	(a)
Electricity(b)	9.8	33.3	2.2	5.0	4.5	(a)

a/ Data not available in published form.

b/ Data for 1955 includes electricity for household use; data for 1963 and 1973 include only agriculturally - related electrical use.

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Table 27. Number and percentage of farms using agricultural equipment, Costa Rica, 1955, 1963 and 1973

Type of Equipment	1955		1963		1973	
	-number-	-percent-	-number-	-percent-	-number-	-percent-
Tractors	504	1.1	4,454	6.9	6,544	9.5
Plows	6,797	14.4	8,865	13.7	6,103	8.8
Planters	112	0.2	629	1.0	1,207	1.7
Harvesters	165	0.3	593	0.9	1,041	1.5
Fumigators	(a)	(a)	8,461	13.1	8,823	12.8

a/ Data not available.

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Table 28. Irrigation of farms, Costa Rica, 1955, 1963 and 1973

Year	Farms	Percentage of total farms	Irrigated area	Percentage of farm area
	--number--	--percent--	--hectares--	--percent--
1955	965	2.0	21,189	1.1
1963	1,919	3.0	25,791	0.7
1973	(a)	(a)	66,362	2.1

a/ Data not available.

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

to 6,544 during the 1955 to 1973 period, this represented less than 10 percent of total farms in 1973. The number and percentage of farms using plows decreased in the same period. Planting and harvesting equipment have had a parallel pattern of change to tractorization, primarily in the flat-land regions of the Guanacaste and Alajuela Provinces, for the production of rice and cotton. While the use of this type of equipment has doubled in the last decade, this represented less than 2 percent of all farms in 1973. Fumigation equipment, primarily for fruit and vegetable crops is presently used on approximately an eighth of Costa Rican farms. Although irrigated area tripled from 1955 to 1973, the 66,362 hectares (164,000 acres) under irrigation represent only 2.1 percent of farm landin a country that experiences a definite dry season from December to April. Most of the irrigated land is attributed to coffee and banana plantations.

Induced Innovation Hypothesis

In previous sections the patterns of growth in total agricultural production were presented. Subsequent sections detailed the relatively slow increases in traditional land and labor production inputs in comparison to the rapid increases in the use of modern fertilizer and power production inputs. In this section, the hypothesis is tested that the substitution of modern production factors for traditional production inputs which has generated agricultural growth in Costa Rica has been induced to a significant extent by trends in relative factor prices.

The results of regression analysis of fertilizer-land, power-land and labor-land ratios with respect to relative price ratios are summarized in Table 29. The results of regression equation FA1 indicate that variations in the ratio of fertilizer and land price indexes explain 86 percent of the variation in fertilizer use per hectare. The price ratio of wage and land indexes indicates a substitution relationship between fertilizer and labor, which may be due to a shift from labor-using organic fertilizers to machine-applied chemical fertilizers. The inclusion of the machinery-land price ratio reveals a slightly complementary effect between machinery and fertilizer, although it does not add to the explanatory value of the equation.

The regression of changes in the power to land ratio as a function of the ratio of machinery to land value price indexes (PA1) reveals that almost 81 percent of the variation in power per hectare is explained. The price ratio coefficient is significant and negative. The addition of the labor-land factor price ratio as an explanatory variable produces significant coefficients that indicate a substitution effect between power and labor. Equation PA3 includes the fertilizer-land price ratio variable. Although this equation shows the complementary relationship between fertilizer and machinery, the theoretically important coefficient of machinery to land price ratio is no longer significant at standard levels.

The regression of the labor-land ratio to their own price index ratio (LA1) produces a theoretically expected negative coefficient with a t-statistic that is not significant at the 0.05 level. This may result from multicolinearity with parallel increases in labor and land

Table 29. Regressions of fertilizer per hectare, power per hectare and labor per hectare on relative factor prices, Costa Rica, 1950 to 1973

Dependent variable	Coefficients of prices of			Coefficient of determination (R^2)	Standard error of estimate	Sample size
	Fertilizer relative to land	Labor relative to land	Machinery relative to land			
FA1 Fertilizer/Hectare	$-2.371^{(a)}$ (0.247)	-	-	0.360	0.482	24
FA2	$-3.015^{(a)}$ (0.173)	$6.530^{(a)}$ (1.310)	-	0.936	0.334	24
FA3	$-3.222^{(b)}$ (1.295)	$8.366^{(a)}$ (1.963)	1.340 (2.358)	0.900	0.328	18
PA1 Power/Hectare	-	-	$-4.593^{(a)}$ (0.560)	0.808	0.269	18
PA2	-	$4.354^{(a)}$ (1.093)	$-3.056^{(a)}$ (0.514)	0.917	0.182	18
PA3	$-2.369^{(a)}$ (0.392)	$4.993^{(a)}$ (0.597)	1.103 (0.744)	0.977	0.099	18
LA1 Labor/Hectare	-	-0.179 (0.365)	-	0.011	0.094	24
LA2	-	-0.023 (0.125)	$0.628^{(a)}$ (0.059)	0.935	0.021	18
LA3	$0.277^{(a)}$ (0.042)	-0.039 (0.064)	0.142 (0.080)	0.984	0.011	18

Note: All equations are log-linear. Standard errors of the estimated coefficients are in parentheses.

a/ Significant at the 0.001 level.
b/ Significant at the 0.05 level.

Source: Data from Appendix II

values through time. The inclusion of the machinery-land price ratio again reveals the substitution relationship between power and labor.

This substitution relationship between horsepower and labor factor inputs is confirmed by the results of regression equation ML1 of Table 30. The variations in the ratio of machinery and farm wage price indexes explain 88.8 percent of the variation in machinery use relative to labor. The coefficient is significant at the 0.001 level and negative as proposed in the hypothesis of induced factor substitution. The regression equation FL1 reveals a similar substitution relationship between chemical fertilizer and labor. Equations ML2 and FL2 indicate a complementary relationship between fertilizer and machinery; price ratio coefficients are not highly significant nor do these equations add significantly to the explanatory value of their respective dependent variables.

In this section, the results of regression equations indicate that the changes in the ratios of modern and traditional production inputs which have occurred in the process of agricultural growth in Costa Rica may be explained in terms of changes in factor price ratios. The increased demands for food and agricultural products that have occurred in the process of economic development, population growth and urbanization in Costa Rica have led to increased productivity of traditional land and labor factors with the addition of modern production inputs from the industrial sector, specifically fertilizer and tractor power. As prices for the less elastic traditional production inputs have increased relative to the more price elastic modern production inputs, Costa Rican farmers have substituted industrially produced capital inputs for land and labor inputs which traditionally have expanded agricultural production.

Table 30. Regressions of machinery to labor and fertilizer to labor ratios on relative factor prices, Costa Rica, 1956 to 1973

Dependent variable	Coefficients of prices of				
	Machinery relative to farm wages	Fertilizer relative to farm wages	Coefficient of determination of (R^2)	Standard error of estimate	Sample size
ML1 Machinery/Labor	$-4.211^{(a)}$ (0.375)	-	0.888	0.230	18
ML2	-1.422 (1.086)	-1.784	0.927	0.196	18
FL1 Fertilizer/Labor	-	$-3.119^{(a)}$ (0.222)	0.899	0.434	24
FL2	$-2.061^{(b)}$ (1.421)	-2.944 (2.323)	0.848	0.419	18

Note: All equations are log-linear. Standard errors of estimated coefficients are in parentheses.

a/ Significant at the 0.001 level.
b/ Significant at the 0.05 level.

Source: Data from Appendix II

CHAPTER IV
URBANIZATION AND URBAN GROWTH

Introduction

Latin America reflects some of the highest levels of urbanization in the entire world. Approximately half of its population is concentrated in cities where disorderly and at times chaotic tendencies of expansion are occurring daily [Trueblood, 1977, p. 1]. The term "urbanization" is used to denote a relatively faster rate of population growth in urban areas than for the rest of the country, and will be used as a proxy for the developmental structure of urban functions. On the other hand, "urban growth" will be referred to in the strictly spatial context of expansion in urban zones. This increase in area occupied by urban residents may or may not occur simultaneously with a demographic growth in rural population, nor does it necessarily reflect upon developmental aspects of the urban zone [UN, 1969, p. 71]. In the Costa Rican case, both processes have occurred in a mutually reinforcing manner. Cities in Costa Rica constitute nuclei of attraction for the masses of peasants displaced by changing rural production systems. The resultant inmigration of rural peasants lies at the origin of the high levels of urbanization and has fostered the expansion of the urban surface through both the primary and secondary effects of increased housing, commercial centers, infrastructural services and employment [Carvajal and Goodwin, 1977, p. 113].

The Primate City

For Costa Rica, San José plays a dominant role in the economic activity of the nation. It serves as the center of the industrial sector, which needs a work force trained in use of equipment and machinery, as well as a managerial elite to administer its operations. It serves as the commercial center of the country where goods are bought, sold and distributed for both the national and international markets. Here as well are the headquarters of the communications network, which facilitates the transport of goods, exchange of ideas, and innovation processes. Financial institutions, the sources of investment for economic growth and development, are centered in the capital city. The offices of the central government, headquarters for the important autonomous institutions which distinguish Costa Rica's political structure, as well as provincial and municipal offices are located here. An important feature is the demographic density of the Costa Ricans who have chosen to live in the Metropolitan Area. This populace permits infrastructural functions to develop on a large scale, which reflects the sophistication of its residents and allows internal economies of scale. Lastly, and fundamental to this thesis, perhaps the richest agricultural soils in the country are located on the valley floor over which this population is expanding.

San José plays a dominant role in Costa Rican affairs, in part due to the proportion of the nation's total population and the high percentage of the country's urban population that resides within its boundaries. Over half of the country's total population is located in the Central Valley (see Table 4). This region has historically played a dominant role in Costa Rican life, even though it encompasses only six percent of the nation's total surface area. Although the Metropolitan Area occupies only a small fraction of the valley floor, its population established its primacy for the entire country.

In 1950, the population of the Metropolitan Areas was less than two hundred thousand, of which half resided within the central city of San José. By the mid 1970s the country's population was approaching two million, a quarter of which was residing in the Metropolitan Area. During this period the proportions of the central city's population dropped to one-fifth of the Metropolitan Area, as migratory flows and natural growth transcended the traditional city limits. The Metropolitan Area registered a 4.25 percent compound annual growth rate during this time period. If this rate of growth continues in the future, then the present population will double in 16 years. During the last two and a half decades, the rest of the country has grown at a 3.5 annual geometric growth rate.

Migration

During the period 1950 to 1963 the cantons of the San José Metropolitan Area registered a positive net in migration of 37,000 people: the majority resettled in the Central; three-quarters of the remainder were concentrated in the eastern portion of the Metropolitan Area, primarily in the cantons of Tibás, Goicoechea and Montes de Oca, which were also the areas undergoing intense urbanization. This was compounded by a movement of inhabitants of the Central Canton outward within the Metropolitan Area. These combined forces led Alberts [1970, p. 113] to speak of "a grand suburbanizing around the Central Canton with its center of gravity in the Eastern Zone."

The 1963 Costa Rican Population Census shows that approximately one third of the residents of the San José Metropolitan Area were born outside the area. The occupational status of the new migrants is pertinent. Of the migrants who moved into the Province of San José from 1950 to 1963, approximately 70 percent previously worked in agriculture and related fields of the primary sector. Of the new migrants to the Metropolitan Area, approximately 45 percent were from rural zones, the remainder from urban zones, especially other provincial centers. An investigation of migratory flows by the Center for Population Studies (CESPO) of the Costa Rican Central University (UCCR) revealed that, of the sample of migrants interviewed, over a quarter of them had been workers in the agricultural sector before arriving in the Metropolitan Area [Bermúdez, 1973, pp. 130-131]. Alberts, in his study of the occupation of migrants to the Metropolitan Area, found a positive correlation between distance from the center of San José and the percentage of agriculturalists [Alberts, 1970, p. 121]. The same districts that reflect high levels of emigration correlate highly with those under rapid urbanization. This feature tends to reaffirm the belief that migration has been a major causative agent of urbanization and has determined, furthermore the changes in the location of agricultural production within the Metropolitan Area.

Urban-Rural Definitions

Consistently throughout the period of 1950 to 1973, over half of the nation's urban population was located in the Metropolitan Area (see Table 4). Urban population is defined as those persons residing in urban areas. The Costa Rican Census Bureau (DGEC) has used the following criteria as a basis for the determination of "urban zones" for the years 1950, 1963 and 1973:

> . . . administrative centers of the cantons of the nation, in other words, the first districts. In these an *a priori* demarcation of said zones was made with a physical criterion: taking into account tangible factors such as blocks, streets, sidewalks, electric lights, urban utilities, etc. [DGEC, 1975, p. xxiii].

Given this determination, the urban population of the Metropolitan Area and the entire nation almost tripled in the past 23 years, at average annual compound rates of 4.53 and 4.39 respectively.

The determination of whether locations of population are "urban" or "rural" may also be viewed in light of minimum population thresholds and the population density, as well as the functional and political-administrative division criteria employed by the Costa Rican Census Bureau. The U.S. Census Bureau has used a combination of the density and minimum population criteria since 1950 in order to delimit "urbanized areas." These areas have been identified as those surrounding a city with a minimum central city population of 50,000 inhabitants, the contiguous municipalities with a population of 2,500 or more, or areas with a minimum density of 1,000 residents per square mile (3.6 persons per hectare). An alternative method, involving data from aerial photographs, stipulates a minimum housing density of 100 units per square mile (38.6 houses per square kilometer) for urbanized areas [Mayer, 1969, pp. 7-8]. These techniques have been applied in varying forms in two recent publications which examine their applicability to the San José Metropolitan Area [INVU, 1975, pp. 22-23; Carvajal and Goodwin, 1977, pp. 123-132].

Table 31 contains information concerning total population and population densities of the cantons and districts of the Metropolitan Area. According to the definition by the U.S. Census Bureau of urbanized zones, in 1950 nineteen of the contiguous forty districts did not meet the minimum population criterion, thirteen districts had population densities lower than 1,000 per square mile, and eleven did not meet either of these two criterion. By 1973, only the district of Sánchez in the Canton of Curridabat did not satisfy the criterion of an urbanized area.

Population Density

The present patterns of population density in the Metropolitan Area suggest a concentric model of resident distribution. At the center are the most densely populated districts of Merced, Hospital, Catedral, Zapote, Hatillo, San Sebastian, Guadalupe and San Francisco (Figure 9). Of these, the first three are districts of the original city of San José, while the dense settlement of the last five has been a function of intensive government housing projects and the introduction of a trolley system to the northeast in the early 1900s (OPAM, 1975, p. 3]. Around this nucleus, grouped in the north, east and south, is a ring of relatively high population density areas. Another ring, less densely populated, is found more distant from the center of the Metropolitan Area. This group is primarily composed of towns which date from pre-Conquest and colonial times and have now been engulfed by the extension of the urban fringe. Beyond this third ring are the peripheral districts of the San José Metropolitan Area. Many

Table 31. Land area, population and population density, Metropolitan Area of San José, canton and district level, 1950, 1963 and 1973

Canton/District	Land area	Population 1950	1963	1973	Density 1950	1963	1973
	-hectares-	--number of inhabitants--			---inhabitants per ha.---		
Central	4,490.973	111,820	168,938	215,441	24.90	37.62	47.97
Carmen	147.375	8,891	9,221	8,442	60.33	62.57	57.28
Merced	216.150	18,920	22,064	19,928	87.53	102.08	92.24
Hospital	329.113	33,858	38,361	34,689	102.88	116.56	105.40
Catedral	236.330	25,240	31,156	28,590	106.80	133.36	120.98
Zapote	285.890	6,895	12,769	17,311	24.12	44.66	60.55
San Fco. de Dos Rios	261.725	2,319	6,422	10,241	8.86	24.54	39.13
Uruca	852.750	2,811	3,766	7,441	3.30	4.42	8.73
Mata Redonda	378.800	1,848	3,373	7,666	4.88	8.90	20.24
Pavas	944.450	2,127	5,530	18,068	2.25	5.86	19.13
Hatillo	456.615	2,936	12,750	31,036	6.43	27.92	67.97
San Sebastian	381.775	5,975	23,166	32,019	15.65	60.68	83.87
Escazú	3,460.425	7,141	14,250	25,026	2.06	4.12	7.23
Escazú	387.025	3,031	6,182	9,858	7.83	15.97	25.47
San Antonio	1,772.375	2,581	4,675	8,405	1.46	2.64	4.74
San Rafael	1,301.025	1,529	3,393	6,763	1.18	2.61	5.20
Desamparados	1,729.300	8,415	21,659	57,954	4.87	12.52	33.51
Desamparados	596.425	4,064	11,511	30,659	6.81	19.30	51.41
San Juan De Dios	276.525	1,276	2,836	6,465	4.61	10.26	23.38
San Rafael Arriba	205.525	1,830	4,577	5,550	4.48	22.27	27.00
San Antonio	215.150	1,245	2,735	5,147	2.72	12.71	23.92
Damas	232.900	(a)	(a)	4,376	(a)	(a)	18.79
San Rafael Abajo	202.775	(a)	(a)	5,757	(a)	(a)	28.39

Table 31 - continued.

Canton/District	Land area	Population 1950	 1963	 1973	Density 1950	 1963	 1973
	-hectares-	--number of inhabitants--			---inhabitants per ha.---		
Curridabat	1,601.973	4,497	9,491	15,591	2.81	5.92	9.73
Curridabat	518.878	2,485	5,764	9,581	4.79	11.11	18.47
Guadalupe	233.565	9,604	21,958	27,016	41.12	94.01	115.67
San Francisco	56.800	2,801	3,900	3,994	49.31	68.66	70.32
Calle Blancos	238.025	5,800	10,836	12,408	24.37	45.52	52.13
El Carmen	795.400	955	1,691	3,569	1.20	2.13	4.49
Ipís	605.250	1,501	4,909	13,389	2.48	8.11	22.12
Alajuelita	964.400	2,733	8.747	18,843	2.83	9.08	19.54
Alajuelita	130.775	1,582	4,280	6,673	12.10	32.63	51.03
Concepcion	290.750	492	3,126	9,280	1.69	10.77	31.92
San Felipe	542.875	659	1,342	2,890	1.21	2.47	5.32
Tibás	872.725	10,594	23,946	35,602	12,14	27.44	40.79
San Juan	365.150	5,621	10,838	18,670	11.09	29.68	51.13
Cinco Esquinas	365.975	4,973	10,624	13,385	13.59	29.03	36.57
Anselmo Llorente	141.600	(a)	2,484	3,547	(a)	17.54	5.32
Moravia	533.825	4,451	9,188	15,552	8.34	17.21	29.13
San Vicente	533.825	4,451	9,188	15,552	8.34	17.21	29.13

Table 31 - continued.

Canton/District	Land area		Population			Density	
		1950	1963	1973	1950	1963	1973
	-hectares-	--number of inhabitants--			---inhabitants per ha.---		
Montes de Oca	1,537.325	9,916	24,043	33,633	6.45	15.64	21.88
San Pedro	459.300	6,413	17,342	23,721	13.96	37.76	51.65
Sabanilla	183.850	1,178	2,447	3,475	6.41	13.31	18.90
Mercedes	141.800	1,358	2,800	3,815	9.58	19.75	26.90
San Rafael	752.375	967	1,454	2,622	1.29	1.93	3.48
Goicoechea	1,929.040	20,661	43,294	60,376	10.71	22.44	31.30
Granadilla	503.125	1,155	2,316	3,685	2.30	4.60	7.32
Sanchez	408.275	564	816	872	1.38	2.00	2.14
Tirrases	171.695	293	595	1,453	1.71	3.47	8.49
Total for the Metropolitan Area	17,119.986	197,736	323,557	464,362	10.50	18.90	27.12

a/ Administrative district not yet created.

Sources: Costa Rican Population Census, 1950, 1963 and 1973;
Office of Metropolitan Area Planning and University of Florida

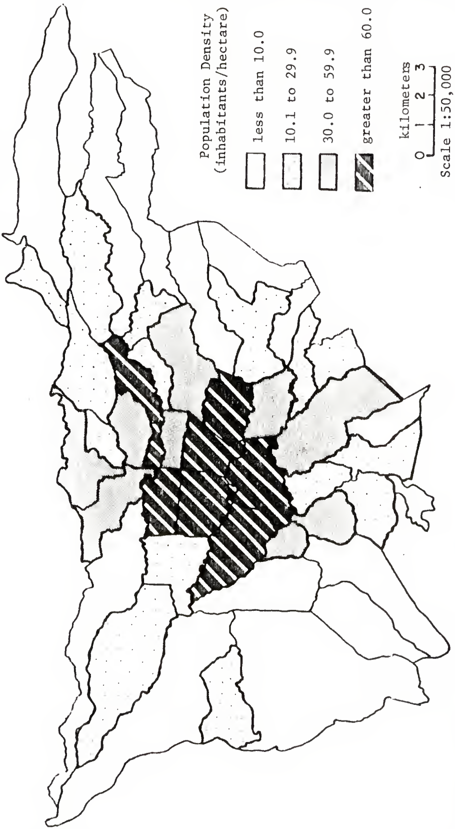

Figure 9. Demografic density, San José Metropolitan Area, 1973

of these districts still retain a rural flavor, but are currently under intense urbanization pressures.

It was postulated earlier that population density was concentrated in the center city and declined in all directions away from the core. Population densities from Table 31 are plotted in hand-fitted density-distance curves measured from the core city for 1950 and 1973 in Figure 10. These curves are very similar to examples derived from U.S. cities by Muth [1961, pp. 207-220] which possessed negative-exponential decline of residential population densities from the center city. When the natural logarithm is taken of the negative exponential form:

$$D_i = D_o e^{-gd_i} \qquad (4.1)$$

where D_i is the density of the i^{th} district, D_o is the central city density and d_i the distance from the central city to the center of the i^{th} district, one obtains the coefficient g or density gradient. This density gradient (the slope of regression of density on distance in natural log terms) provides a measure of the spread of the urban population.

The results of regression analysis for population density (in inhabitants per hectare) for the years 1950 and 1973 on distance from the center of San José are summarized in Table 32. The antilogarithms of the intercept values indicate that the estimated population density in the center city increased from 68.3 to 137.5 inhabitants per hectare (17,682 to 35,597 persons per square mile) from 1950 to 1973. This increase in population density reflects an average annual compound growth rate of 3.04 percent. The decrease in the absolute value of g indicates that this increased population density had spread out into

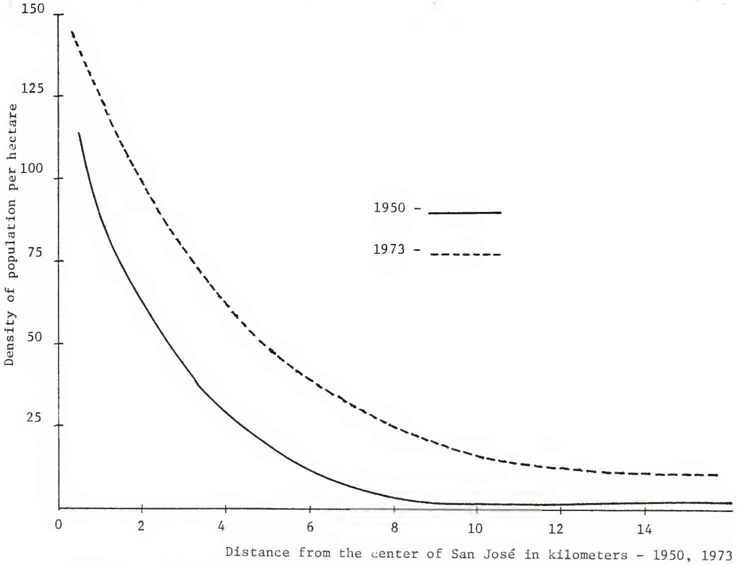

Figure 10. Relationship of population density and distance from the center of San José

the surrounding areas. In other words, the rate of decline in density as one goes out from the center city is less in 1973 than in 1950.

Table 32. Regressions of population density on distance from the center of San José, 1950 and 1973

Year	Coefficients		Coefficient of determination (R^2)	Standard error of estimate	Sample size
	D_o	g			
1950	4.224(a) (0.261)	-0.471(a) (0.049)	0.735	0.711	36
1973	4.923(a) (0.236)	-0.356(a) (0.044)	0.658	0.644	36

Note: Equations are natural log-linear. Standard errors of estimated coefficients are in parenthesis.

a/ Significant at the 0.001 level.

Differential Population Growth

An examination of intercensal population data for the years 1950 to 1963 and 1963 to 1973 reveals that population growth rates have not been uniform. The areas of relatively high and lower annual growth for these two decades are shown in Figures 11 and 12. Average annual percentage growth rates are recorded by districts in Table 33. In the thirteen years from 1950, the four central districts of San José City registered low growth rates and in the next decade experienced a loss of population with corresponding negative rates of growth. This reflects the process of a substitution governmental offices and commercial facilities for residential housing.

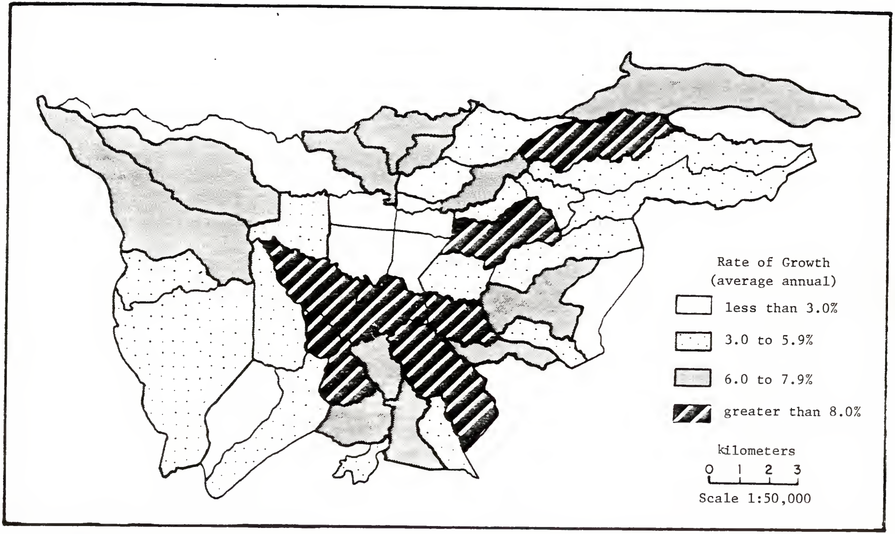

Figure 11. Average annual percentage population growth rates, San José Metropolitan Area, 1950 to 1963

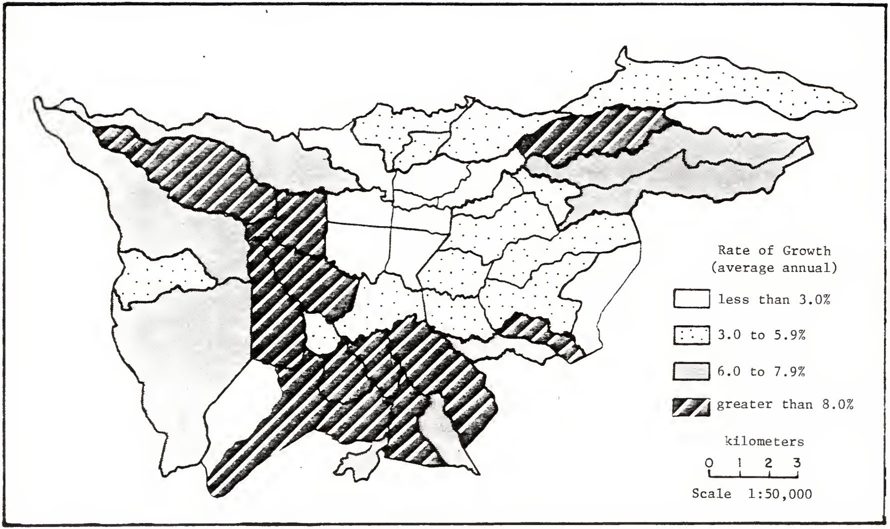

Figure 12. Average annual percentage population growth rates, San José Metropolitan Area, 1963 to 1973

Table 33. Average annual population growth rates, 1950 to 1963 and 1963 to 1973, and distance from the center of San José for districts within the Metropolitan Area

Administrative division	Average annual growth rate 1950-1963	Average annual growth rate 1963-1973	Distance from the center of San José
	-------percent-------		---kilometers-----
Central	3.2	2.5	
Carmen	0.3	-0.9	1.00
Merced	1.2	-1.0	1.25
Catedral	1.7	-1.0	1.25
Hospital	1.0	-1.0	1.38
Zapote	4.9	3.1	2.62
San Sebastian	11.0	3.3	2.62
Mata Redonda	4.7	8.6	3.12
Hatillo	12.0	9.3	3.12
San Fco. de Dos Ríos	8.2	4.8	3.88
La Uruca	2.3	7.0	4.75
Pavas	7.6	12.6	6.75
Escazú	5.5	5.8	
Escazú	5.6	4.8	8.00
San Rafael	6.3	7.1	8.25
San Antonio	4.7	6.0	8.38
Desamparados	7.1	8.9	
Desamparados	8.3	10.3	5.25
San Antonio	6.2	6.5	5.62
San Rafael(a)	7.3	9.5	6.00
San Juan de Dios	6.3	8.6	6.75
San Miguel(b)	4.7	6.0	8.62
Patarrá(c)	8.1	8.1	10.00
Goicoechea	5.9	3.4	
San Francisco	2.6	0.2	1.13
Calle Blancos	4.9	1.4	2.25
Guadalupe	6.6	2.1	3.38
Ipís	9.5	10.6	7.62
Carmen	4.5	7.8	9.75

Table 33 - continued.

Administrative division	Average annual growth rate 1950-1963	Average annual growth rate 1963-1973	Distance from the center of San José
	-------percent-------		---kilometers-----
Alajuelita	8.1	7.8	
Alajuelita	8.0	4.5	4.50
San Felipe	5.6	8.0	5.00
Concepcion	15.8	11.5	5.38
San Josecito	5.4	8.2	8.00
San Antonio	2.3	3.2	8.25
Tibás	6.5	4.0	
Cinco Esquinas	6.0	2.3	2.75
San Juan	6.9	5.2	3.25
Moravia	5.7	5.4	
San Vicente	5.7	5.4	4.62
Montes de Oca	7.1	3.4	
Mercedes	5.7	3.1	3.62
San Pedro	8.0	3.2	3.88
Sabanilla	5.8	3.6	5.62
San Rafael	3.2	6.1	10.12
Curridabat	5.9	5.1	
Curridabat	6.7	5.2	5.50
Granadilla	5.5	4.8	5.88
Tirrases	5.6	9.3	6.38
Sánchez	2.9	0.7	7.38

a/ Includes all of the San Miguel District.
b/ Includes San Rafael Abajo.
c/ Includes Damas.

During the 1950s and early 1960s accelerated demographic growth was concentrated in the districts adjacent to the central city on the south and east, and to a lesser degree in those districts located in the same directions at greater distances from the central city. During this period, Tibás to the north was also the sight of a take-off in population growth.

This pattern of growth changed radically between 1963 to 1973. Those districts to the south and adjacent to the central city which experienced such rapid growth in the previous decade, such as San Sebastian, Alajuelita and San Francisco de Dos Ríos, appear to have reached a point of saturation and register much lower growth rates. Meanwhile, the districts further south of these are the ones involved in a process of rapid population expansion. A similar shift in population dynamics is seen in the difference between the eastern and western sections of the Metropolitan Area. Whereas the eastern districts were the site of growth in population concentrations in the 1950s, they now appear to be reaching a saturation point. The west and southwest portions of the area, traditionally sectors of intense agricultural production, are experiencing rapid demographic growth.

Dynamics of Population Growth

When one studies land-use maps of the last quarter century [Beck, 1965; PNDU, 1972; INVU, 1976] one is struck by the similarity of the sudden burst of population over the landscape and the dynamic characteristics of an explosion. Waves of migrants have emanated outward from the once compact, linearly laid out center of the colonial city of San José, and have spread out into the former envelope of agricultural lands that surrounded the city. The effect of this rapid population expansion on agricultural lands--coffee plantations, sugar cane fields, cultivated plots and pastures--has been dramatic. Those lands that have remained in agriculture are small and fragmented near the core, with somewhat larger, irregular-shaped parcels farther out. This pattern quickly merges with similar type explosions, albeit on a smaller scale, in Santo Domingo, Heredia and Alajuela in a northwestern vector, and Tres Ríos and Cartago to the east.

In order to provide a more graphic view of the waves of population which have emanated from the center of the Metropolitan Area, the average annual arithmetic growth rates of the districts were plotted over distance from the center of San José. This suggested the equations of the following form as the hypothetical relationship between core city proximity and the average rate of demographic expansion:

$$r_{1i} = \alpha_{10} + \beta_{11}d_i + \beta_{12}d_i^2 + \varepsilon_{1i} \qquad (4.2)$$

$$r_{2i} = \alpha_{20} + \beta_{21}d_i + \beta_{22}d_i^2 + \varepsilon_{2i} \qquad (4.3)$$

where

r_{1i} and r_{2i}	are the i^{th} district population arithmetic growth rates for the period 1950-1963 and 1963-1973, respectively
d_i	is the distance in kilometers between the spatial center of the district and the center of the Metropolitan Area
α_{10} and α_{20}	are the intercept values
β_{11} and β_{12}	are the linear coefficient terms
β_{21} and β_{22}	are the quadratic coefficient terms

ε_{1i} and ε_{2i} are the stochastic error terms

$i=1,\ldots, 43$ are the districts identified in Table 33

Least squares estimation techniques reveal the following estimates, together with standard errors, F-statistics and multiple regression coefficients (MRC) [Carvajal and Goodwin, 1976, pp. 140-145]:

$$r_{1i} = 1.40032 + 1.83304^{(a)} d_i - 0.1546^{(a)} d_i^2 \qquad (4.4)$$

$$(0.56584) \qquad (0.04700)$$

$$F = 5.286^{(a)} \qquad MRC = 0.209$$

$$r_{1i} = -3.54963 + 3.08324^{(a)} d_i - 0.21173^{(a)} d_i^2 \qquad (4.5)$$

$$(0.53818) \qquad (0.04470)$$

$$F = 21.191^{(a)} \qquad MRC = 0.515$$

a/ indicates <.01 level of confidence.

The predicted population growth rate curves based upon these equations are plotted in Figure 13. The intercept values indicate that those districts at the center of the city were still experiencing an estimated 1.4 percent annual growth rate in the 1950-1963 period but in the next decade were rapidly losing population. The combination of positive linear coefficients and negative square terms indicate that, for both time periods, the growth rate tends to increase at a decreasing rate as one travels from the center of the city, reaches a peak, and then begins to decrease. The first derivatives show a maximum rate of 6.98 percent at 6.09 kilometers from the center of the city for the 1950-1963 period, and a slightly higher peak growth rate of 7.68 percent annually at a distance 1.19 kilometers further from the center for

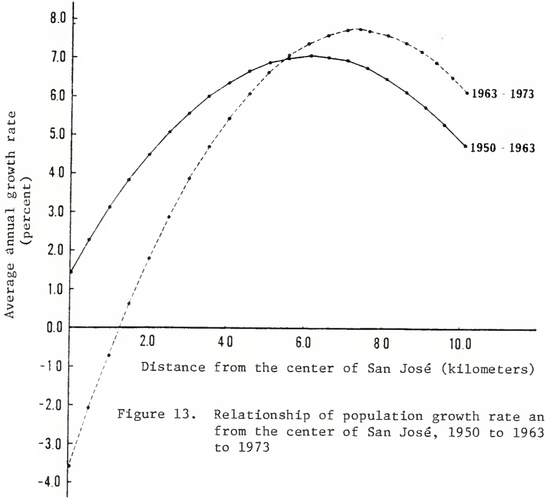

Figure 13. Relationship of population growth rate and distance from the center of San José, 1950 to 1963 and 1963 to 1973

the next decade. The areas located within a five-kilometer radius of the center city were experiencing a greater growth in the first intercensal period, whereas, during the last decade, those districts which lie beyond this ring experienced the greater growth in population [Carvajal and Goodwin, 1976, p. 145]. The second derivatives reveal that this dynamic wave of population is accelerating by a factor of 1.41 each decade. A continuation of these patterns of change through 1973-1983, means that this wave of population, which has emanated from the center of the Metropolitan Area outwards, will have its peak growth rate of 8.44 percent average annual arithmetic increase at 10.24 kilometers from the center city.

Urban Expansion in the Metropolitan Area

The concentration of urban population in the San José Metropolitan Area in the past two and a half decades has occurred with a simultaneous expansion in the area urbanized. As population numbers have increased, so has the pressure for a growth in topographical space in which this increased population has sought shelter, place of employment, commercial and business locations, supportive infrastructure and recreational space. This process of urbanization and urban growth is at the crux of this thesis--for as urban population grows, so does the demand for agricultural products increase; yet as this population moves outward, it continuously competes for the space in which these agricultural commodities may be produced.

In order to track the expansion of urbanized area, two methods have been employed. The first method uses the "effective area urbanized", or that area which is in urban development and effectively excluded from agricultural production. The results of this analysis, which provides a time-serial view of urban spatial expansion, are summarized in Table 34. The other method involves a much more detailed, cross-sectional perspective of land use by urban function, and is presented in the next section.

The trends in land effectively under urban development, population growth, changes in the settlement density, and an indication of the rate at which the area is being converted to urban purposes are shown in Table 34. From 1950 until 1973 the area effectively under urban functions increased two and a half times from an initial urban area of 2,529 hectares (9.8 square miles) to 6,267 hectares (24.2 square miles), which represents an increase in the proportion of area in development from 14.8 to 36.6 percent. This expansion of urban area in San José proceeded at an average rate of 162.53 hectares per year (401.62 acres per year) an average compound rate of 4.38 annually. If this trend continues in a similar fashion for the next two decades, a projected 87.94 percent of the area will be urbanized. This may have serious ecological repurcussions, as an estimated 26.6 percent of the area has slopes of more than a 20 percent grade and has been deemed unsuitable for urban construction by the Metropolitan Area Planning Office (OPAM) [INVU, 1975, p. 9].

Population density increased during the period of population growth in the core city and declined during the period of suburbanization. From 1950 to 1963, the density of inhabitants per hectare increased from 71.08 to 81.09 or from approximately 18,400 to 20,000 inhabitants per square mile. With an expansion outward towards suburban areas and a rate of development of urban land slightly greater

Table 34. Actual and estimated area under urban development, total population, population density and percentage of total area under urban development, San José Metropolitan Area, selected years, 1950 to 1993

Year	Urban area developed	Total population	Population density	Urban area developed
	-hectares-		inhabitants --per ha.--	--percent-
1950	2,529	179,736	71.08	14.77
1955	2,848	225,337(a)	79.14	16.63
1963	3,990(b)	323,557	81.09	23.31
1973	6,267	478,018	76.28	36.61
1983	9,713(b)	701,590(a)	72.23	56.74
1993	15,056(b)	1,060,011(a)	70.41	87.94

a/ Estimated with geometric growth rate, r = 4.13.
b/ Estimated with geometric growth rate, r = 4.38.

Sources: Costa Rican Population Census, 1950, 1963 and 1973
INVU, 1976

than the rate of population increase, per capita land consumption increased with a resultant decline in the trend of population density. A similar trend has been noted in the United States where average densities for cities and their surrounding areas with populations of 50,000 or more experienced a 28 percent decline in urban densities, from 5,400 inhabitants per square mile in 1950 to 3,890 inhabitants per square mile in 1960. This trend of a decline in urban densities has been attributed not only to decreases in residential density but also to an increase in non-residential urban land use per capita [Mayer, 1969, p. 21].

Urban Land Use in the Metropolitan Area

Urban centers arise as people locate in mutual proximity for the purpose of establishing functions that would not be possible or as efficient in areas of lower density. Thus cities act as nodes of interaction among people, institutions and physical facilities. Whereas agricultural production is dependent upon proximity to markets and the inherent fertility of the soil, urban functions and their establishments, which may be defined as "individuals or groups occupying recognizable places of businesses, residence, government or assembly within or upon units of land" [Mayer, 1969, p. 8], are more dependent upon access to locations where these functions may interact in a complementary fashion. One of the phenomena of urban sites is the development of spatial patterns of urban functions. In this section, the locational characteristics and patterns of urban functions will be described together with the resultant effect of the economic competition among these functions for locational proximity, as reflected in land value demand curves derived for the San José Metropolitan Area.

The National Institute of Housing and Urbanization conducted a survey of land use in the Metropolitan Area early in 1973. This survey took inventory of 16,533 hectares of land defined as urban within the Metropolitan Area. The land use categories used by INVU in its survey are defined as follows:

(a) Housing: land predominantly devoted to residences, including single- and multiple-family units, as well as area in residential streets.

(b) Private Enterprise: all land uses occupied by the private sector in commerce, warehouses, professional services, education, recreation, etc.

(c) Industry: land occupied by manufacturing and agricultural industries.

(d) Government Services: land used by the public sector for services -- ministries, autonomous agencies, airports, hospitals, public schools, water treatment plants, electrical generating plants, etc.

(e) Green Areas: parks, recreation and sports areas.

The distribution among these five urban land use categories appears in summary form for the entire Metropolitan Area in Table 35 and disaggregated to the level of cantons and districts in Table 36. Almost two-thirds (62.8 percent) of the developed area is used for residential housing, followed in importance by business and commercial private enterprise, governmental services, industry and green spaces.

The use of urban locations for private enterprise forms a definite pattern within the San José Metropolitan Area. From the center city there is a band of business and commercial interests which runs from northwest to southeast. To the south and north of this band are

Table 35. Land use, San José Metropolitan Area, 1973

Land Use	Area	Developed land	Total metropolitan area
	-hectares-	-----------percentage	------------
Housing	2,397	62.9	14.5
Private enterprise	476	12.5	2.9
Industry	305	8.0	1.9
Government services	423	11.1	2.5
Green areas	209	5.5	1.3
Developed area	3,811	100.0	23.0
Undeveloped area	12,723		76.9
Total area	16,533		100.0

Source: INVU, 1976

Table 36. Percentage of surface area developed for urban use, administrative divisions of the San José Metropolitan Area, 1973

Administrative division	Land Use				
	Housing	Private enterprise	Industry	Government services	Green areas
	percentage				
Metropolitan Area	62.8	12.3	8.6	10.5	5.8
Canton Central	54.6	16.3	7.6	13.7	7.8
Carmen	56.5	21.6	4.0	11.1	6.8
Merced	57.9	27.8	4.2	9.0	1.1
Hospital	41.6	22.3	8.4	22.6	5.1
Catedral	61.5	22.3	3.2	9.3	3.7
Zapote	72.1	10.9	3.7	8.5	4.8
San Fco. de Díos	75.6	5.5	10.9	1.3	6.6
Uruca	19.6	33.3	21.3	20.4	5.4
Mata Redonda	39.9	11.7	5.4	6.9	36.1
Pavas	34.6	10.9	16.4	33.7	4.4
Hatillo	84.3	3.2	1.2	5.7	5.6
San Sebastian	81.4	5.6	2.4	3.9	6.7
Escazú	76.4	9.7	5.0	3.9	5.0
Escazú	89.2	4.4	0.8	4.1	1.5
San Antonio	84.9	2.5	---	8.0	4.6
San Rafael	65.4	16.4	10.0	14.	6.8
Desamparados	72.6	8.5	5.0	8.5	5.4
Desamparados	74.2	7.1	4.0	7.7	7.0
San Juan de Díos	73.1	4.1	10.4	8.5	3.9
San Rafael	46.3	14.1	9.8	27.2	2.6
San Antonio	78.0	4.1	7.7	5.5	4.7
Damas	71.0	25.2	1.1	0.4	2.3
San Rafael Abajo	88.9	5.8	1.6	0.9	2.8
Goicoechea	72.3	7.1	10.7	6.7	3.2
Guadalupe	78.8	8.9	3.4	7.2	1.7
San Francisco	71.3	9.3	8.6	8.0	2.8
Calle Blancos	58.6	7.2	27.2	5.5	1.5
Carmen	77.9	3.7	8.9	4.5	5.0
Ipís	71.5	4.3	10.4	7.1	6.7

Table 36 - continued.

Administrative division	Land Use Housing	Private enterprise	Industry	Government services	Green areas
	percentage				
Alajuelita	83.1	3.5	4.8	3.3	5.3
Alajuelita	75.1	6.8	4.3	6.3	7.5
Concepción	92.1	2.1	---	1.7	4.1
San Felipe	77.9	1.0	14.9	1.8	4.4
Tibás	67.8	6.4	13.4	9.3	3.1
San Juan	80.4	6.6	4.9	6.6	1.5
Cinco Esquinas	49.5	4.1	27.4	16.4	2.6
Anselmo Llorente	66.1	11.9	9.7	0.6	11.7
Moravia	59.1	26.4	6.6	3.0	4.9
San Vicente	59.1	26.4	6.6	3.0	4.9
Montes de Oca	74.5	5.2	5.4	13.4	1.5
San Pedro	77.3	6.5	5.1	9.8	1.3
Sabanilla	82.0	1.3	3.9	6.7	6.1
Mercedes	52.1	1.5	2.6	42.6	1.2
San Rafael	80.3	1.8	14.9	3.0	---
Curridabat	48.9	7.4	31.5	5.8	6.4
Curridabat	46.7	7.4	37.8	4.1	4.0
Granadilla	58.3	13.4	23.0	0.8	4.5
Sánchez	47.8	0.3	30.2	2.2	19.5
Tirrases	41.0	2.7	3.3	45.4	7.6

Source: INVU, 1976

located two other centers of business and commerce which have traditionally developed on either side of the two rivers that traverse the Metropolitan Area. With regard to governmental services, an initial concentration was clustered historically in the center city and contiguous to this area in the eastern zone. Agencies of the national government, especially the autonomous institutions, are now dispersed around the perifery of the Metropolitan Area. Industrial functions are located on the fringe of the urban area along access routes and transportation nodes. An analysis of housing clusters in the urban zone reveals lower concentrations of housing units where governemental services, private enterprise and industrial processes have tended to locate. Residential housing and industrial enterprises have the lowest relative economic competition for site location in the Metropolitan Area.

The economic relationship of urban location is depicted in Figure 14. Average land values in colones per square meter are plotted over distance from the center of San José in an easterly direction for the years 1961, 1968 and 1974. This vector is overlayed with the corresponding primary land use zones for the year 1974. At the center of the city are located the offices of the central government (note the official ceiling on land values) followed by a business section that extends approximately one kilometer and a small section of residential housing that has not yet been displaced by the other two functions. This cycle of government-business-housing is then repeated over the next kilometer. Land in this section is relatively inexpensive in comparison with the center city, with a shift in the factor share of space towards residential neighborhoods. Beyond this tri-band extends

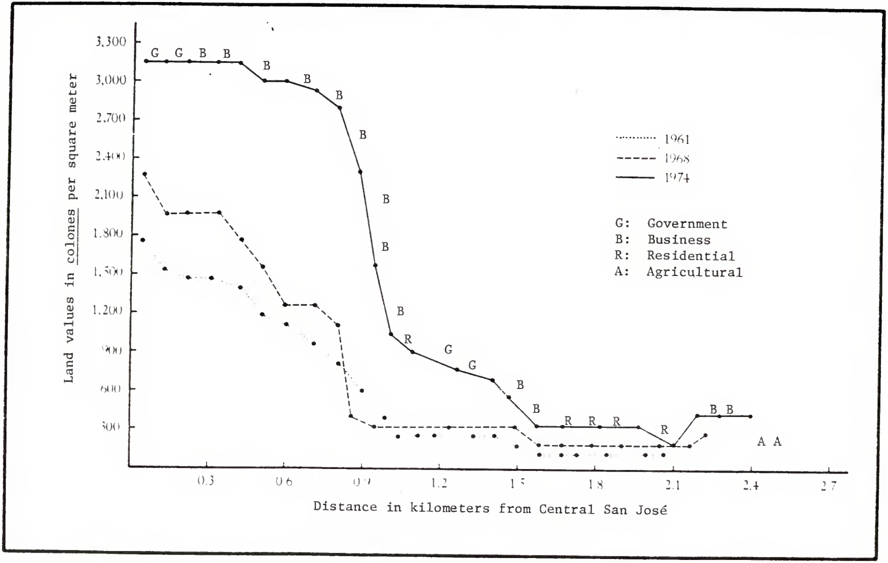

Figure 14. Average land values in *colones* per square meter and predominant land use from the center of San José, easterly direction, 1961, 1968 and 1974

small business districts, dispersed, newly-founded industrial concerns and housing, which eventually merges with small plot, intensively cultivated agriculture. These findings for the Metropolitan Area are summarized in Table 37. In the next chapter the effects of this expansion of urban area and its populace on the farm sector are described and analyzed.

Table 37. Land values for predominantly urban areas with typical land use and locations, San José Metropolitan Area, 1973

Land values in colones per square meter	Predominant location	Typical usage	Approximate radial location (Kms.)	Political division
Greater than ₡1000	Central Business District	Government, commercial	0.0 - 1.0	City of San José
₡200 - 1000	Center city	Residential, business, government	1.0 - 2.0	San Pedro, La Sabana, Cinco Esquinas, Uruca
₡50 - 200	Incorporated cities	Urban settlement, some agriculture	2.0 - 4.0	Tibás, Alajuelita, Guadalupe, Zapote
₡20 - 100	Satellite cities	Urban clusters, agriculture	4.0 - 6.5	Curridabat, Desamparados, Moravia, Sabanilla, Pavas, Escazú

CHAPTER V
AGRICULTURE UNDER URBAN PRESSURE

Introduction

With the closure of the frontier for agricultural expansion and a continuation of increases in population, the inhabitants of Costa Rica have tended to reconverge towards the urban zones within the Central Plateau. As the process of urbanization in the Central Plateau has intensified, there has been a corresponding increase in pressures on rural land resources around urban cores to supply both additional space and products from the primary sector. Several effects may be noted as urban centers expand into formerly rural-agricultural zones. The first and most obvious consequence is the reduction in the number of farms and farm lands. As the population within urban centers has grown in total numbers, there has been a consequent change in the regional economic structure, standards and consumption patterns. These developments reveal the second major effect on the surrounding agricultural sector, that of changes in the combination of enterprises to meet the changing demands. Concomitant with changes in land utilization, alterations occur in the patterns of farm tenancy and the legal status of farm operators. The last effect to be discussed involves changes in production techniques. As the area available for agricultural use diminishes, the demands for primary products increase and the yields with respect to land must increase accordingly to avoid serious economic repercussions.

Gaitskell, in consideration of the importance of agriculture in economically developing areas, observed this problem in the following similar context:

> The increase in the population as a whole, the increase in the numbers who no longer grow their own food because they have joined the urban and industrial sectors, and the increasingly sophisticated type of food which higher incomes and better nutrition demand, are all placing more and more strain on many developing countries. Unless their own agriculture can supply these needs, the countries must import or run a serious risk of inflation and possibly famine [Gaitskell, 1968, p. 54].

This section focuses upon the San José Metropolitan Area as a microcosm of changes in rural productive structure and output under the pressures of increasing population and urbanization. An analysis of the effects of changes, mentioned in the preceding paragraph, during the last two decades, and case studies of specific areas within the Metropolitan Region are presented in the remainder of this chapter.

Farms and Farm Lands

The process of population concentration in the Metropolitan Area during the last 25 years has caused a displacement of agricultural lands. Basically this displacement is a result of the competition for land use between traditional agricultural enterprises and urban demands. The competitive opportunity cost for urban use, reflected in the market price for land, has bid land costs or rent above the returns obtained from agricultural production. The largest shift in urban area has occurred in the use for housing and related space-consuming uses such as streets and highways, schools, industrial and commercial centers, and space consumed in public infrastructure, especially utilities. The process of urban expansion into rural areas also involves:

> . . . a substantial area not yet in urban use but in immediate juxtaposition with the town, which is substantially blighted or even sterilized for agriculture by impending change and by other kinds of urban intrusion. Moreover, this conversion process is virtually irreversible; land once converted to urban use is most unlikely to return to any form of agricultural production [Tarrant, 1973, p. 232].

Land that was formerly in coffee plantations and other agricultural uses, which not long ago was on the outskirts of San José, has succumbed to the urban advance. Farms and farm land in the six cantons totally within the Metropolitan Area were diminished by 54.8 percent during this period (Table 38). An average of 22 farms per year were converted to urban use. The area in farm land was diminished by 47.1 percent, an average rate of 258 hectares (627 acres) per year. From the reduction in average size of farm one may deduce that the larger parcels of land were converted to urban use. The concomitant effect is that those remaining farms are smaller, which tends to reduce economy-of-scale advantages for the remaining agricultural enterprises.

Similar data on farms and farm area are provided for the "amplified" Metropolitan Area in Table 39. This region includes all of nine cantons, portions of which compose the "official" Metropolitan Area, and encompasses approximately two and a half times the legal definition (see Appendix I). During the intercensal period, 1950 to 1963, when the central and eastern portions of the Metropolitan Area were in the process of urban population growth, two-thirds of these cantons in the amplified region registered declines in the number of farms or farm area. The net increase in agricultural area of 3,941 hectares (9,580 acres) was primarily due to a total increase of 4,816 hectares (11,900 acres) of new farmland in the cantons of Desamparados and Moravia, which are contiguous to the areas of recent urbanization on the south and east,

Table 38. Number of farms and area in farm land for selected cantons, San José Metropolitan Area, 1955, 1963 and 1973

Canton	Farms			Area		
	1955	1963	1973	1955	1963	1973
	--------number-------			-------hectares------		
Central	248	145	60	2,967	2,521	783
Escazú	357	318	305	2,466	2,642	1,722
Alajuelita	159	173	151	1,473	1,386	973
Tibás	92	101	43	535	681	243
Montes de Oca	138	131	94	878	865	573
Curridabat	125	97	70	1,559	1,190	933
Total(a)	1,119	965	723	9,878	9,285	5,227

a/ Does not include the cantons of Desamparados, Goicoechea or Moravia.

Sources: Costa Rican Agricultural Census, 1955 and 1963; computer tape of 1973 Agricultural Census, LADB

Table 39. Number of farms and land area in farms, cantons of the amplified San José Metropolitan Area (SJMA), 1955, 1963 and 1973

Canton	Census I.D. number	1955		1963		1973	
		-number(a)	---hectares-	-number(a)	---hectares-	-number(b)	---hectares-
Central	101	248	2,967.0	145	2,521.4	60	783.3
Escazú	102	357	2,466.1	318	2,641.9	305	1,721.9
Desamparados	103	997	8,963.8	1,059	11,608.7	1,011	8,683.2
Goicoechea	108	216	5,368.9	251	5,087.0	190	8,192.6
Alajuelita	110	159	1,473.1	173	1,386.2	151	973.0
Tibás	113	92	534.8	101	680.7	43	243.3
Moravia	114	188	1,698.8	206	3,870.3	187	2,110.7
Montes de Oca	115	138	878.4	131	865.1	94	573.2
Curridabat	118	125	1,559.4	97	1,189.9	70	932.6
Total for SJMA		2,520	25,910.3	2,481	29,851.2	2,111	24,213.8
Average farm size			10.3		12.0		11.5

a/ A farm was considered to be "all land extension of one manzana or more dedicated totally or partially to crop and livestock production whose labor is executed, directed or administered by a single person or with the aid of others" [DGEC, 1959, p. XII and 1965, p. XXI].

b/ Computations were made only for those farms with a land area equal to or greater than 0.699 hectares = 1 manzana.

Sources: Costa Rican Agricultural Census, 1955 and 1963; computer tape of 1973 Costa Rican Agricultural Census, LADB respectively. Relatively large land holdings, with an average size of slightly over 60 hectares (150 acres), were being established in these cantons, with a resultant rise in area-wide average farm size from 10.3 hectares (25.5 acres) in 1950 to 12.0 hectares (29.7 acres) in 1963. In the following decade, when adjacent rural areas came under pressures of "suburbanization", all cantons, with the exception of Goicoechea which has extensive lands outside the official Metropolitan Area, experienced a decline in farm units and area. During this period, one-fifth of the land in the primary sector was retired into other uses at an average rate of 565 hectares (1,400 acres) per year.

The proportional shifts in the distributional shares of farms and their lands within the amplified San José metropolitan region are shown in Table 40. The center-most canton, those cantons having previously established urban centers (Escazú and Alajuelita), and cantons along the main transport routes (Montes de Oca, Curridabat, Tibás) have experienced a fairly steady decline in both number and percentage share of farms and area in farm land. Only those cantons which encompass extensive lands outside the "official" Metropolitan Area or those which are marginal in terms of terrain and access to the urban centers have been able to maintain or increase units and area in farms.

Data in Table 41, which includes cantons for which reliable estimates of total land area exist, indicate the relative extent of area in agricultual land use. In 1950, approximately 70 percent of the Metropolitan Area was in farms, a figure which rose to 78.1 percent eight years later. During the next decade, when the residential areas of the center city were displaced by commercial and governmental districts, the resultant process of suburbanization caused farm land to be reduced to one-half the total area.

Table 40. Distribution of number and area of farms, cantons of the amplified San José Metropolitan Area (SJMA), 1955, 1963 and 1973

Canton	1955		1963		1973	
	Number of farms	Land area	Number of farms	Land area	Number of farms	Land area
	---percent---					
Central	9.8	11.5	5.8	8.4	2.8	3.2
Escazú	14.2	9.5	12.8	8.9	14.4	7.1
Desamparados	39.6	34.6	47.7	38.9	47.9	35.9
Goicoechea	8.6	20.7	10.1	17.0	9.0	33.8
Alajuelita	6.3	5.7	7.0	4.6	7.2	4.0
Tibás	3.6	2.1	4.1	2.3	2.0	1.0
Moravia	7.5	6.6	8.3	13.0	8.9	8.7
Montes de Oca	5.5	3.4	5.3	2.9	4.5	2.4
Curridabat	5.0	6.0	3.9	4.0	3.3	3.9
Total for SJMA	100.1	100.1	100.0	100.0	100.0	100.0

Source: Table 39

Table 41. Percentage of total land area devoted to agricultural use, selected cantons, San José Metropolitan Area, 1955, 1963 and 1973

Canton	Total area	Area in agriculture 1955	1963	1973
	-hectares-	----------percent-----------		
Central	4,491	66.1	56.1	17.4
Escazú	3,460	71.3	76.3	49.7
Desamparados	12,625	71.0	91.9	68.8
Alajuelita	2,154	68.4	64.3	45.2
Tibás	873	61.2	78.0	27.9
Montes de Oca	1,537	57.1	56.3	37.3
Curridabat	1,602	97.3	74.3	58.2
Total for SJMA(a)	26,742	70.5	78.1	52.0

a/ Does not include the cantons of Goicoechea or Moravia.

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Within the Central Canton in 1973, the four districts that compose the city of San José no longer had agricultural land and only small islands of farm land existed in the surrounding districts, representing only 17.4 percent of an area that 18 years prior was two-thirds covered with agricultural production. During the 1963 to 1973 decade all of the cantons, especially those in the new suburban zone, registered losses of agricultural production. Fifty percent of the total area of Tibás was lost from primary sector production. Escazú and Curridabat, which in 1963 had three-fourths of their area in farms, had this percentage reduced to 49.7 and 58.2, respectively. Desamparados, farmed almost in its entirety in 1963, had two-thirds of its area remaining in farm land ten years later. Both Alajuelita in the south and Montes de Oca in the east had nearly 20 percent of their total area converted from rural to urban use.

Institutional Arrangements

As land is converted from rural to urban uses, the institutional aspects of tenure and legal status of farm operators may change. Such was the outcome as indicated by a study of farms in England; under the influence of urbanization, there was a shift from tenant-operated to owner-operated farms [Gasson, 1966, p. 74]. Costa Rican farms, especially those in the Central Plateau, since colonial times were predominantly small and owner-operated (Tables 42 and 43). Nine out of ten farmers in this region owned their farms in 1955, and this proportion increased by 6 percent in the next 18 years. These relatively high percentages of ownership reflect the proximity of legal institutions in the capital city and the process of urbanization itself. Such

Table 42. Tenure of farmers, cantons of the amplified San José Metropolitan Area (SJMA), 1955, 1963 and 1973

Canton	1955(a)			1963(a)			1973(b)		
	Owned	Non-owned(c)	Owned	Owned	Non-owned(c)	Owned	Owned	Non-owned(c)	Owned
	------number------		-percent-	--------number----		-percent-	--------number----		-percent-
Central	234	14	94.4	139	6	95.9	58	2	96.7
Escazú	286	71	80.1	294	24	92.5	283	22	92.8
Desamparados	892	105	89.5	941	118	88.9	994	17	98.3
Goicoechea	198	18	91.7	228	23	90.8	179	11	94.2
Alajuelita	158	1	99.4	166	7	95.9	150	1	99.3
Tibás	92	---	100.0	100	1	99.0	43	---	100.0
Moravia	194	4	97.9	199	7	96.6	182	5	97.3
Montes de Oca	133	5	96.4	127	4	97.0	93	1	98.9
Curridabat	119	6	95.2	94	3	96.9	68	2	97.1
Total for SJMA	2,296	224	91.2	2,288	193	92.2	2,050	61	97.1

a/ Original data converted 1.0 manzana = 0.699 hectare.
b/ Selected from computer records, only those farms with land area ≥ 0.699 ha.
c/ Includes rented, share-cropped, free, without permission, colonists, other and mixed forms.

Sources: Costa Rican Agricultural Census, 1955 and 1963; computer tape of 1973 Costa Rican Agricultural Census

Table 43. Land area by form of farm tenure, cantons of the amplified San José Metropolitan Area, 1955, 1963 and 1973

Canton	1955(a)			1963(a)			1973(b)		
	Owned	Non-owned(c)	Owned	Owned	Non-owned(c)	Owned	Owned	Non-owned(c)	Owned
	------number------		-percent-	------number------		-percent-	------number------		-percent-
Central	2,938	29	99.0	2,194	327	87.0	762	21	93.3
Escazú	2,214	252	89.8	2,451	191	92.8	1,638	94	95.1
Desamparados	8,439	525	94.1	10,721	888	92.4	8,335	348	96.0
Goicoechea	5,014	355	93.4	4,694	393	92.3	8,032	161	98.0
Alajuelita	1,465	8	99.5	1,359	27	98.1	930	43	95.6
Tibás	535	---	100.0	674	6	99.1	242	1	99.5
Moravia	1,679	20	98.8	3.712	158	95.9	1.766	335	83.7
Montes de Oca	852	26	97.0	853	12	98.6	572	1	99.8
Curridabat	1.541	18	98.8	1,079	111	90.7	920	13	98.7
Total for SJMA	24,677	1,233	95.2	27,737	2,113	92.9	23,197	1,017	95.8
Average farm size	10.75	5.55		12.12	10.95		11.32	16.67	

a/ Original data converted 1.0 manzana = 0.69 hectare.
b/ Selected from computer records, only those farms with land area ≥ 0.69 ha.
c/ Includes rented, share-cropped, free, without permission. colonists, other and mixed forms.
Sources: Costa Rican Agricultural Census, 1955 and 1963; computer tape of 1973 Costa Rican Agricultural census

is the case in Escazú, formerly an agricultural suburb of San José and currently undergoing rapid urbanization, where ownership has increased markedly. This may be the response of farmers who wish to establish clear titles in preparation for the legal transition to urban use.

Ownership by land area reveals a tendency that is even more pronounced when one considers the legal status of farmers in the Metropolitan Area. As expected, the vast majority of land parcels are small, owner-operated units which average between 10 and 11 hectares (26 to 28 acres), equal to three-tenths the national average. Yet the average size of land parcels that are farmed by non-owners (renters, sharcroppers and other forms) has increased from 5.6 to 16.7 hectares (14 to 41 acres) in the last two decades. This tendency towards larger holdings among farmers who are not single-owner occupants is more meaningful when one considers the legal status of the owners.

While the ownership pattern per se has altered little during this recent period of urbanization, there has been a shift towards more complex, modern types of legal ownership status -- such as corporations, cooperatives and collectives -- and especially the quantity of land under their control, as single ownership farms and their land area have declined. Single owners still account for nine out of ten owned farms, yet there has been a significant increase in the number of multiple ownership entities (Table 44). The impact of this shift in ownership structure on land area under different legal status can be noted in Table 45. While in 1955 the single owners accounted for two-thirds of all farm land in the metropolitan region, the single and multiple owner farms were approaching equality of farm area less than two decades later. Even more striking is the fact that multiple-owner farms tended

Table 44. Legal status of farm operators, cantons of the amplified San José Metropolitan Area, 1955, 1963 and 1973

Canton	1955			1963			1973(a)		
	Single owner	Multiple ownership(b)	Other(c)	Single owner	Multiple ownership(b)	Other(c)	Single owner	Multiple ownership(b)	Other(c)
	---number of units---								
Central	214	25	9	98	33	14	39	19	2
Escazú	355	1	1	304	13	1	281	21	3
Desamparados	976	20	1	1,004	33	22	959	45	7
Goicoechea	185	23	8	216	23	12	170	20	---
Alajuelita	155	4	---	159	10	4	138	13	---
Tibás	88	4	---	88	11	2	34	9	---
Moravia	181	7	---	186	17	3	173	14	---
Montes de Oca	121	16	1	101	26	4	75	18	1
Curridabat	115	9	1	76	15	6	56	13	1
Total for SJMA	2,390	109	21	2,232	181	68	1,925	172	14
Percentage. status of total	94.8	4.4	0.8	89.9	7.3	2.8	91.2	8.1	0.7

a/ Only farms with land area ≥ 0.699 ha. = 1.0 mz. selected from computer records.

b/ Includes legal associations, cooperatives, family collectives, silent partners, limited liability and stock companies, etc.

c/ All other types, especially those owned by religious, education or governmental institutions.

Sources: Costa Rican Agricultural Census for 1955 and 1963; computer tapes of 1973 Costa Rican Agricultural Census

Table 45. Land area by legal status of farm operators, cantons of the amplified San José Metropolitan Area, 1955, 1963 and 1973

Canton	1955(a)			1963(a)			1973(b)		
	Single	Multiple(c)	Other(d)	Single	Multiple(c)	Other(d)	Single	Multiple(c)	Other(d)
	----------	----------	----------	----------	hectares	----------	----------	----------	----------
Central	1,161	1,381	464	525	1,511	519	186	513	84
Escazú	2,482	5	13	2,138	539	1	1,455	258	9
Desamparados	7,863	1,221	1	8,437	3,159	170	6,381	2,007	295
Goicoechea	2,328	3,093	20	2,672	2,438	44	2,602	5,591	---
Alajuelita	905	588	---	849	499	57	599	374	---
Tibás	455	87	---	372	261	57	105	138	---
Moravia	1,213	508	---	2,137	1,770	15	1,298	812	---
Montes de Oca	448	412	30	377	442	57	317	237	20
Curridabat	792	676	112	579	367	260	176	697	59
Totals for SJMA	17,648	7,972	640	18,086	10,987	1,180	13,119	10,626	467
Percentage area	67.2	30.4	2.4	59.8	36.3	3.9	54.2	43.9	1.9
Average farm size(e), hectares	7.4	73.1	30.5	8.1	60.7	17.4	6.8	61.8	33.4

a/ Original data in manzanas (mz.); 1.43 mz. = 1.0 ha.
b/ Calculations made for farms with land area ≥ 1.0 mz.
c/ Includes legal associations, cooperatives, family collectives, silent partners, limited liability and stock companies, etc.
d/ All other types, especially those owned by religious, educational or governmental institutions.
e/ Calculated from figures in Table 44.

Sources: Costa Rican Agricultural Census, 1955 and 1963; and computer tapes of 1973 Costa Rican Agricultural Census to be eight to ten times the average size of the single owner farm. As legal status has developed in complexity, there has been a corresponding increase in the amount of land farmed under these more complex institutional forms.

To follow the transition process of rural to urban land conversion on a micro scale is beyond the scope of this study. Yet a pattern of this conversion seems to have emerged as urban pressures have mounted. The small, singly-owned farms either sell directly to urban interests or are merged by larger corporate interests. These multiple owners, who possess both better abilities to speculate and to produce more profitably, eventually sell to urban developers. In the 1950s this was already the case in the Central Canton. Since then this pattern seems prevalent in those cantons subject to pressures from suburbanization.

The effect of governments' speculative role in the land market may be noted by sharp increases and decreases in the "other" category of agricultural lands (Table 45). During the 1960s, extensive land tracts were purchased by the National Institute of Housing and Urbanization [INVU] to be used for public housing. With funds from the Alliance for Progress, former farm lands were converted into public housing projects, focusing primarily in the districts of the Central Canton, Desamparados, Goicoechea, Alajuelita, Tibás and Curridabat [Carvajal and Goodwin, 1977, pp. 145-150]. The INVU still has substantial reserves in Desamparados and in the southern portion of the Central Canton.

Agricultural Land Use

As the urbanized area of San José has expanded, different agricultural land uses have not changed uniformly. The conversion of land for urban uses appears to be dependent not only upon the need for space, but also upon the demands of the urban population for farm products. The juxtaposition of concurrent demands for living space and food products has worked at cross purposes and as a result has given rise to a unique character of urban expansion into rural lands. As indicated previously, the effect of increases in per capita income has been a greater demand for certain agricultural products -- especially vegetables, meats and animal products -- and a declining demand for "inferior" goods, such as grains and staples. This fact, when balanced against increasing expenditures on housing as income rises, is reflected in the conversion of rural to urban land and the subsequent trade-offs among lands committed to different agricultural uses. This section examines the changes in agricultural land use patterns and offers empirical evidence to support the economic explanation of these divergent patterns in the Metropolitan Area.

An insight may be gained of the marked changes in land use patterns for agricultural purposes from the data presented in Tables 46 and 47. In the last two decades land in annual crops, representing starches and vegetables, has declined steadily with a loss of approximately a third of the area cultivated in 1955. The largest absolute loss of productive land was registered in permanent crops, primarily coffee plantations which are located near the urban limits. These enterprises have lost approximately 30 percent of their land to the urban sector at an average rate of 377 hectares (1,033 acres) per year over the last reported decade.

Table 46. Agricultural land use by categories, amplified San José Metropolitan Area, 1955, 1963 and 1973

Year	Annual	Fallow	Permanent crops	Pasture	Forest & brush	Other	Total
				hectares			
1955	1,419	627	10,158	8,336	5,039	341	25,910
1963	1,162	889	10,843	9,637	6,777	544	29,851
1973	961	522	7,075	11,476	3,478	701	24,214

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Table 47. Percentage area in agricultural land use categories, amplified San José Metropolitan Area, 1955, 1963 and 1973

Year	Annual	Fallow	Permanent crops	Pasture	Forest & brush	Other	Total
				percent			
1955	5.5	2.4	39.2	32.2	19.4	1.3	100.0
1963	3.9	3.0	36.3	32.2	22.7	1.8	100.0
1973	4.0	2.2	29.2	47.4	14.4	2.8	100.0

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

The percentage share of total farm land for permanent crops has shifted steadily downward, from 39.2 percent in 1955 to 24.2 percent in 1973. A similar effect can be noted with forest lands which were reduced by a half in the last ten-year period. The resultant decline in relative share of farm land in timber and brush was from 22.7 to 14.4 percent.

The only increases in agricultural land uses from 1955 to 1973 were registered in natural and improved pasture lands and in the "other" category, which represents land for on-farm capital improvements, such as new roads, greenhouses, equipment and storage sheds and other farm buildings. The steady increase in the "other" category reflects the increases in accommodations for capital and other variable inputs necessary for increased yields. Although this category is relatively small, representing 1.3 percent of farm land area in 1955 and rising to 2.8 percent in 1973, its multiplicative effect upon agricultural production establishes its indicative value. The increases in pasture lands are equally significant. While total farm land registered a net loss, 3,140.3 hectares (7,760 acres) were added in pastures. Grazing lands rose from a third of the agriculturally productive area in 1955 to almost a half 18 years later. This expansion may be due to the more intensive use of land for dairy cattle, an enterprise that requires proximity to urban-industrial centers for processing and necessitates a stable market for its relatively high-priced, perishable products, and increased demands for beef meat.

A major contributive element in this divergent pattern of land use change can be found in the differentiated demands of the urban market that these agricultural enterprises serve. The relatively high demand for meats and animal products by the expanding population has undoubtedly affected the growth of land in pastures within the area. Retail prices per pound of beef increased from ₡1.25 to ₡5.94 from 1950 to 1973, rising over 2.3 times faster than the food price index for the same period [DGEC, 1950-1973]. Income elasticity for beef was estimated in Chapter III to be 0.78. With average household monthly income for the inhabitants of the Metropolitan Area estimated at ₡1,846 ($215) as compared to rural families with comparable incomes of ₡796 ($92) per month [Cespedes, 1973, p. 53], a cattle industry in the proximity of a growing urban center becomes a more viable enterprise. A similar case can be made for milk products. Milk prices per bottle increase 68 percent from 1950 to 1973. Urban residents, with a relatively high marginal propensity to consume milk and an effective demand two and a third times greater than rural residents, consume 80 percent more milk products than their rural counterparts [Cespedes, 1973, p. 69]. For this reason, milk enterprises, like the Tres Pinos Milk Cooperative, have flourished in the highly populated Central Plateau.

The converse case of consumption demand as an influence on urban to rural land conversion explains the declines in annual and permanent crop land and forest areas. During a recent study concerning urbanization in Costa Rica [Carvajal and Goodwin, 1977], the authors estimated the income elasticity for private housing rents to be 1.54 in the Metropolitan Area, comparable to findings by Muth [1961, p. 19]. Considering that empirical estimates of income elasticities for selected annual crops ranged between -0.395 for corn and 0.050 for rice (see Table 17), and extending Muth's argument of the national food crop to the international export crop, coffee, it can be deduced that urban lands would more readily expand at the expense of annual and permanent crop lands than at the expense of pastures. The tremendous decline in forest land follows from the increased demands for housing construction materials and the traditional evolution from forest to pastures in agricultural development.

In this section economic forces were seen to be the determinants not only of the expansion of urban areas, typified by a high effective demand for housing, but also as explanations of the particular pattern of this conversion of agriculturally productive land into urban lots. Differentiated consumer food demand has acted as a guide to which agricultural lands will succumb to the urban advance, and in some cases, expand to meet the increased demands for particular products. In the next section a related phenomena is revealed -- that of increased yields to the land resource. This fact is considered in light of urban advance in selected zones of the Metropolitan Area.

Rural - Urban Land Use Changes

In order to typify the changes in urban and rural land use, representative areas which have undergone the process of rural to urban land conversion were selected. The criteria for selection were the existence of comparable, time-sequential aerial photographs, the configuration of agricultural enterprises, distance from the central city of San José and the nature of land conversion process. The first case encompasses approximately 15.35 square kilometers (≈ 6 square miles) located in Tibás on the northern edge of the Metropolitan Area. This canton is the most proximate, less than three kilometers from the center city, produced primarily coffee and underwent intense urbanization pressures beginning around 1950. The second case study area contains approximately 22.67

square kilometers (8.75 square miles), and includes the western portion of the Central Canton and the Canton of Escazú, located 8 kilometers west of the center city. This area was industrialized and suburbanized only recently. Escazú has a more diversified agricultural structure than Tibás, consisting of cattle, coffee and sugar plantations and horticultural crops.

In the northwestern quadrant of Figure 15 is the city of Santo Domingo of the Heredia Province, and in the southern half of the photograph is the town of Tibás, District San Juan of the San José Province. The River Virilla runs between these two towns, from east to west, and forms the northern border of the San José Metropolitan Area. This aerial photograph depicts Tibás in 1945, with almost the identical 71 blocks that had been laid out in the midst of coffee plantations by a decree in 1835. At that time, President Carrillo wanted to shift the capital from Cartago to Tibás. After the "League's War", San José was named the nation's capital [Rodriguez and Beck, 1967, p. 61]. Tibás remained essentially unchanged in physical appearance for the next century with well-laid out streets separating manzanas or blocks of coffee trees. Pasture lands were located along the southern edge of the Tiribi River and extended into the northeastern portion of the town where a few buildings were scattered in a central six block area. Five years earlier, during the Cortés Administration, the road which led north from San José to Tibás was paved -- a factor which fostered the conversion of this area from coffee plantations to a satellite city of the Metropolitan Area [Rodriguez and Beck, 1967, p. 109].

Tibás had begun to urbanize in 1950 when it was included in the a priori definition of the Metropolitan Area by the Costa Rican Census

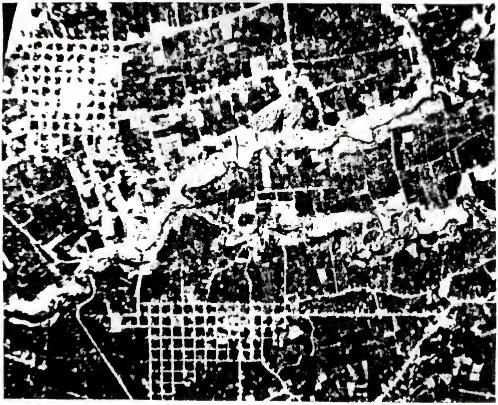

Figure 15. Aerial photograph, Tibás -- Santo Domingo quadrant, 1945

Note: North is at top; scale approximately 1:20,000

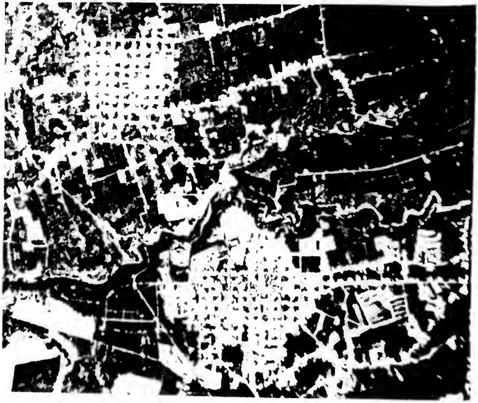

Figure 16. Aerial photograph, Tibás -- Santo Domingo quadrant, 1973

Bureau [DGEC, 1953, p. 8]. As new inhabitants arrived to the already densely populated capital area, migrants crossed the Torres River into Tibás. By 1973, the old coffee manzanas had been replaced by buildings (Figure 16). The national government, in attempts to solve chronic housing shortages, had constructed two public housing projects to the east and another project in the northwest corner of the city. This district, that less than two and a half decades prior to 1973 had been composed of two-thirds rural residents, was considered totally urban. Urban land accounted for over half the developed area of the district with 117.7 urban hectares [INVU, 1975, p. 9]. and only 112.2 hectares in crop land in 1973 [DGEC, 1973a, p. CR2].

Data presented in Table 48 reveal the effects of urban expansion during the period 1955 to 1973 on agricultural land use and show productivity for typical enterprises related to these land uses for the entire canton of Tibás. Although agricultural production typically varies greatly from year to year, these data provide an indication of trends in production and productivity. Of the 535 hectares (1,321 acres) in farms in 1955, three-quarters of this area was planted in permanent crops (primarily coffee plantations), a fifth was used for pastures, and the remainder was used for annual crops (primarily corn and beans) and forests. By 1973, less than half of the total farm land remained in agricultural use, the difference having been incorporated into urban areas. The greatest absolute loss was registered in coffee land, which lost almost half its area to urban encrouchment. Annual crops lost a third of their previous area, pastures were reduced from 91.8 to 6.8 hectares (227 to 17 acres), and forests became relatively nonexistant.

The production response of farmers was to increase yields per unit land as the total supply of land available for agriculture declined.

Table 48. Areas in agricultural land uses and yields, Tibás Canton, 1955 and 1973

Land use category--typical enterprise	Area		Units	Yield	
	1955	1973		1955	1973
	------hectares------			---per hectare---	
Permanent -- Coffee	406.4	222.5	*quintal*	4,196.0	6,610.0
Annual -- Corn	14.5	9.0	*quintal*	363.0	735.0
Pasture -- Cattle	91.8	6.8	head	1.52	3.38
Forest and brush	19.3	3.0			
Other farm land	2.8	2.0			
Total	534.8	243.3			

Sources: *Costa Rican Agricultural Census*, 1955 and 1973

Coffee yields increased by more than 50 percent, corn yields doubled and pasture lands now support over twice as many cattle as in 1955. A fundamental question concerns whether the reduction of crop and livestock lands has been compensated by increases in yields. In the case of corn, used for local human and animal consumption, this trade-off of land for yield has produced a net increase in total production by 25 percent since 1955. Coffee production has suffered a 14 percent decline and the number of cattle has been reduced from 139 to 23. Unfortunately, data do not readily exist that demonstrates a shift from beef to dairy cattle, or a significant change in milk, cheese or butter production per land area unit.

An even more striking example of the urban expansion during the period under study may be seen by the comparison of Figures 17 and 18. These pictures encompass approximately 22.67 square kilometers (8.75 square miles) of portions of Central and Escazú Cantons. The Tiribi River flows from southeast to northwest and separates the two cantons. A triangular portion of the Hatillo District can be distinguished in the southeastern portion of the photographs between the Tiribi and Maria Aguilar Rivers; the latter river is the southern border of San José city. Directly north of the Maria Aguilar lies the Mata Redonda District of the Central Canton. A large rectangular grassland area called the Sabana may be distinguished in the upper right hand corner of the photographs. This area was the first to be mentioned in colonial Spanish land sale folios of the present day San José Metropolitan Area [Rodriguez and Beck, 1967, p. 21].

The National Stadium and five-year old National Airport [Rodriguez and Beck, 1967, p. 75] may be seen in the 1945 aerial photograph (Figure

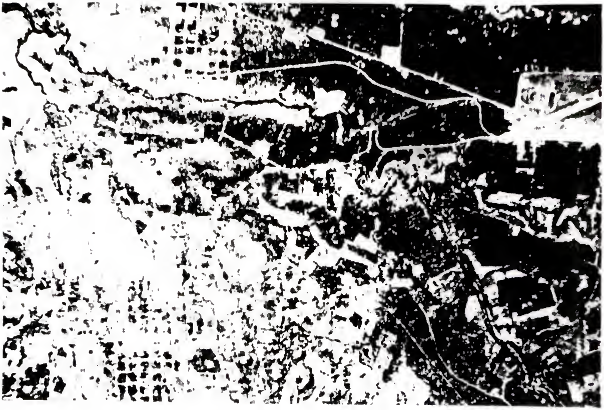

Figure 17. Aerial photograph, Escazú and western portion of Central Canton, 1945

Note: North is at top; scale approximately 1:20,000

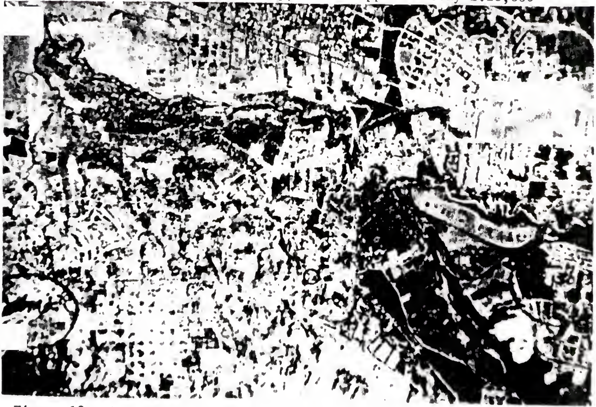

Figure 18. Aerial photograph, Escazú and western portion of Central Canton, 1973

17), located in the northwest corner and diagonally across the Sabana. The Electric Railroad to the Pacific runs along the southern edge of the Sabana and heads westward above the Tiribi River through Pavas. National Highway Route 1 parallels the railroad along the Sabana and then loops across the Tiribi towards San Rafael in the Canton of Escazú. Here, this primary transport link is joined by the León Cortés Regional Highway that extends southward into the city of Escazú, the matrix of streets in the southwest quadrant of the photograph.

The 1945 aerial photograph demonstrates that approximately an eighth of the total area was in urban use. Since the mid-19th century the lands of Mata Redonda and Pavas had been planted in coffee [Andrade, 1967, pp. 93-4, and Rodriguez and Beck, 1967, pp. 51-52]. Hatillo, which in Spanish signifies "small livestock holdings", is interspersed with pasture and coffee lands. The districts of Escazú contain an eastern border of coffee along the Tiribi River. To the southwest of this coffee strip lies a band of pasture and sugar cane fields. Around the city of Escazú proper can be seen a mixture of small-holder, cultivated agriculture, small pastures and patches of coffee within the city limits.

The more recent photograph of this area (Figure 18) shows essentially four types of urban expansion into formerly rural-agricultural zones. Displacement of formerly agricultural lands has been precipitated by large public and private housing projects, similar to those found in Mata Redonda and Hatillo; industrial development and housing for workers in the secondary sector, typified by the urban expansion in Pavas; new upper-middle class and wealthy suburban residential areas in Escazú and San Rafael; typical line settlements which develop along transport arteries; and finally dispersed settlements within rural areas which portend the beginning of urban expansion.

Housing has been the primary use for the land displaced from agricultural production. The most dramatic example of this land use shift has occurred in Hatillo. Since the formation of the National Housing and Urban Affairs Institute (INVU) in 1954, over ₡ 57 million (US$ 6.7 million) has spent on construction for lower and middle-income housing [INVU, 1974, Table 8]. Rent for houses in this area averaged ₡ 171.80 (US$ 20.12) per month in 1973. In Figure 18 can be discerned the newest fringe of INVU housing projects, tracts of land held in passive reserve by the institution, and those actively under development. Housing in this area accounts for 84.3 percent of the developed surface area [INVU, 1975, p. 11]. The area west of Hatillo across the Tiribi River, known as La Verbena, is also included in INVU housing reserves.

Around the Sabana in Mata Redonda District, a similar phenomena of housing project expansion may be noted. Here the developments of Rohrmoser and Las Américas have been constructed with private capital for upper-middle and higher class occupants. Housing rents in these areas were among the highest in the Metropolitan Area in 1973, averaging over ₡ 2,000 (US$ 235) per month. The National Airport has been eliminated and the Sabana is now used exclusively for sports events and recreational purposes [Rodriguez and Beck, 1967, p. 86]. If land that is not fit for urban expansion and the area of the Sabana are deducted from the total area of Mata Redonda, the result indicates almot three-quarters of this area is now urbanized [INVU, 1976, p.p. 9-11]. Less than 1 percent of the area of Mata Redonda is still in coffee production that once covered these lands [DGEC, 1973a, p. CR8].

In contrast to the orderly urbanization of Mata Redonda and Hatillo, Pavas represents an area of urban sprawl. Less than a quarter of a century ago, this district was considered totally rural. Today it is completely urban and forms one of the few slum areas of San José. As industry located along both sides of the Pacific Railroad tracks, spontaneous settlements were spawned to the north. In many areas of Pavas, rents averaged less than ₡50.00 (US$ 5.85) per month in 1973 and over a third of the houses have been deemed in poorly constructed and deteriorated condition. Houses in Pavas are the most crowded in the Metropolitan Area with an average of 6.05 inhabitants per dwelling and 3.54 persons per bedroom. An eighth of the households in this district still use latrines for toilets in a city that takes pride in its modern sanitary facilities. The remaining agricultural lands of Pavas have been converted from coffee plantations to small plots of cultivated lands, which reflects the rural character of migrants into this district, 31.2 percent of whom lived in other cantons in 1968, the highest migratory rate for the Central Canton [INVU, 1975, p. 6].

Escazú, a site of Indian occupation at the time of the Conquest and a place of rest for travelers to the south and west in colonial times [Rodriguez and Beck, 1967, p. 30], has undergone tremendous changes in landscape over the past three decades. The rich farm lands that were once cultivated for the markets of San José have been converted to suburban settlements for the wealthy. Less than a sixth of the area in the Escazú District remained in agricultural production in 1973 [DGEC, 1973a, p. CR13]. Much of the formerly agricultural land was bought for residences for the monied families of San José and foreigners, especially those of the embassies and international missions [Rodriguez and Beck, 1967, p. 100]. The names of new residential sections such as Belo Horizonte and Vista Alegre reflect the higher altitude, cooler climate and pleasant living conditions of this region. Typical of the new style of living of Escazú is the Costa Rican Country Club in San Rafael, which appears as a large trapezoid northwest of the Escazú quadrant.

While over three-quarters of the agricultural lands in the Central Canton in 1955 were converted into urban use by 1973, the less proximate rural lands of the Canton of Escazú experienced a more moderated decline. Thirty percent of the productive agricultural land in Escazú was converted into urban areas during this period (Table 49). The primary loss was in forests which declined by 285 hectares (700 acres), with only a fifth of its prior stock remaining. Permanent, annual and pasture lands each lost approximately 160 hectares (400 acres) to suburbanization; the greatest proportional decrease was in annual crop lands (primarily corn and beans) which were reduced in half. Significantly, in the face of ubiquitous decline in crop and livestock land area, the "other" category -- farm roads, buildings, etc. -- increased. Concurrently, yields of the three indicator enterprises also increased: coffee production per hectare almost doubled; corn yields rose 50 percent; and pastures supported 30 percent more cattle in 1973 than 18 years earlier. Significant as well was the shift from beef cattle to dairy production. This fact is reflected in the change in the ratio of cows to steers from an even proportion in 1955 to over two to one in 1973.

The case studies of landscape change in the urban and rural zones of the Metropolitan Area presented in this section depict several tendencies. One is the rapid displacement of agriculturally productive areas by urban advance. The extent and rate at which this conversion

Table 49. Areas in agricultural land uses and yields, Escazú Canton, 1955 and 1973

Land use category--typical enterprise	Area		Units	Yield	
	1955	1973		1955	1973
	------hectares------			---per hectare---	
Permanent -- Coffee	738.3	579.2	quintal	2,029.0	3,787.0
Annual -- Corn	343.7	188.5	quintal	644.0	976.0
Pasture -- Cattle	990.8	827.5	head	1.35	1.76
Forest and brush	356.0	71.3			
Other farm land	37.2	55.0			
Total	2,466.1	1,721.9			

Sources: Costa Rican Agricultural Census, 1955 and 1973 occurs depends upon the region's proximity to the central city of San José, the configuration and composition of the agricultural enterprises in the areas surrounding the settlement centers, the type and function of urban expansion, governmental policies, and natural barriers. One of the consequences of the decline in productive primary land resources has been an increase in yield per hectare. This phenomenon and the characteristics of its development will be analyzed in the next section.

Yield and Spatial Production Response

The response of producers of agricultural commodities in the San José Metropolitan Area -- faced with reduced supplies of available land, increased demand for their products from a growing urban population, a competitive disadvantage with urban sources of employment and competition from producers in other regions -- has been to substitute yield-increasing inputs for land and labor. In this section, agricultural enterprises typical of those in the Metropolitan Area -- coffee, corn and cattle -- are examined with respect to changes in production area, number of farm units, quantity and value of production, yields and the spatial expression of the changes in yields during the period 1955 to 1973. Data which reveal the development of agriculturally productive activity are presented to demonstrate the changes in land and technology used by farmers in the capital city area.

Coffee has played a dominant role in the agricultural development of Costa Rica. Coffee exports in 1973 still accounted for 36.5 percent of total agricultural trade earnings (see Table 12). Costa Rican production of the "brown gold" was initiated in the Central Plateau. In 1973 half of Costa Rican coffee producers were located in this region, which accounted for two-thirds of the country's total production [DGEC, 1975, Tables 73 and 125]. The rapid urbanization of the Metropolitan Area has placed increasing pressure upon coffee plantations. The result has been a reduction of the proportion of the country's total number of coffee farms located in the Metropolitan Area from 10 to 5 percent, a decline in relative share of area planted from 16.7 to 7.2 percent and a similar decline in the contribution to the nation's coffee production from 20.0 to 7.4 percent in the last two decades.

Production statistics for coffee in the Metropolitan Area are presented in Table 50. These data reveal a decline in the number of farms and area in coffee plantations with a concurrent growth in total production compensated for by increases in yields. Due to the stationary nature of permanent crops, production responses to changes in prices experience a considerable lag. During the early and mid-1950s, coffee exports were bolstered by high prices (see Chapter III, Export Crops). The effect of this demand was the addition to total coffee lands and increases in yields between 1955 and 1963. With the drastic decline in coffee prices during the 1960s and increasing pressure from the urban sector for living space, the next decade witnessed a 40 percent decline in total planted area, a reduction by a fifth of average area per farm in coffee, and a loss of one-quarter of the number of coffee farms in the area. Coffee plantations traditionally were located near the center city. With the decline in coffee prices and land values relative to high urban land prices (see Chapter II), coffee lands were rapidly transformed into urbanized areas. Agricultural land losses to the urban sector were irreversible. With national coffee price stabilization, producers increased yields by 70 percent in the following decade. Even though this increase in yield per hectare more than compensated for

Table 50. Coffee production and value, all ages and varieties, San José Metropolitan Area, 1955, 1963 and 1973

Item	Unit	1955	1963	1973(a)
No. of farms	Units > 1.0 mz.	2,206	2,183	1,637
Area cropped	Hectare	9,569(b)	10,187(b)	6,030
Total production(c)	100 Kilogram	195,277(d)	272,020(d)	274,815
Area cropped/farm	Hectare	4.34	4.67	3.68
Production/ha.	100 Kilogram	20.41	26.70	45.58
Production/farm	100 Kilogram	88.52	124.61	167.88
Average price	Current ₡/100 Kgs.	173.27(e)	143.62(e)	112.84(f)
Price index	1962 = 100	90.8 (g)	103.0	117.5 (h)
Value of production	Current ₡ 1,000	33,836.3	39,066.7	31,009.4
Value of production	Constant ₡ 1,000	37,264.6	37,928.9	26,391.0

a/ Computations were made for only farms with area equal to or greater than 0.699 hectare = 1 manzana.
b/ Original data in manzanas; 1.43 mz. = 1.0 hectare.
c/ Home consumption accounts for less than 1/10 of 1 percent of total production.
d/ Original data in fanega = 400 lbs. = 181.44 kilograms.
e/ Calculated from estimates of country-wide total value product and census data.
f/ Represents a weighted average of canton prices.
g/ 1957 price index used as approximation of 1955.
h/ Extrapolated due to change in basis year from 1962 to 1966.

Sources: Costa Rican Agricultural Census, 1955 and 1963; computer tapes of 1973 Costa Rican Agricultural Census, LADB; MAG-OFIPLAN, 1965; unpublished data from BCCR and LADB losses in planted area, inflationary pressures and low but rising prices accounted for 1973 earnings being 30 percent lower than value of production in constant colones in 1963.

The increases in coffee yields under pressures of urban advance in San José may be noted from data in Table 51. Average increases in yields for coffee were 1,237 kilograms per hectare from 1955 to 1963, and 719 kilograms per hectare from 1963 to 1973. Although coffee yields may vary from one year to the next, these increases in yields represent statistically significant differences (at the 0.025 level of confidence) for one-tailed, paired difference tests for small samples [Mendenhall, 1964, pp. 192-196; and Richmond, 1964, pp. 190 and 576].

Table 52 contains results of regression equations of the following form:

$$Y_{1i} = \alpha_{10} - \beta_{11}d_i - \beta_{12}d_i^2 - \varepsilon_{1i} \qquad (5.1)$$

$$Y_{2i} = \alpha_{20} - \beta_{21}d_i - \beta_{22}d_i^2 - \varepsilon_{2i} \qquad (5.2)$$

where

Y_{1i} and Y_{2i} are coffee yields in kilograms per hectare for the ith canton for 1955 and 1973, respectively

d_i is the distance from the center of the principal production area in the ith canton and the center of San José

α_{10} and α_{20} are the intercept values

β_{11} and β_{21} are the linear coefficient terms

β_{12} and β_{22} are the quadratic coefficient terms

ε_{1i} and ε_{2i} are the stochastic error terms

$i = 1, \ldots, 9$ are the cantons as indicated in Table 51

Estimated and observed coffee yield values are plotted in Figure 19.

Table 51. Coffee yields, cantons of the amplified San José Metropolitan Area in order of increasing distance from principal production areas to the center city, 1955, 1963 and 1973

Canton	1955	1963	1973
	-------kilograms per hectare-------		
Central	4,247	5,729	6,459
Tibás	4,196	5,914	6,610
Montes de Oca	2,956	3,902	4,313
Curridabat	3,363	4,146	6,954
Alajuelita	1,376	3,094	3,478
Moravia	2,862	4,325	4,254
Escazú	2,029	3,214	3,787
Goicoechea	3,109	3,912	4,149
Desamparados	2,014	3,053	3,752

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Table 52. Regressions of coffee yields in kilograms per hectare on distance from center of San José in kilometers, 1955 and 1973

Year	Coefficients of			Coefficient of determination (R^2)	Standard error of estimate	Sample size
	α	β_1	β_2			
1955	7812.9(a) (2158.2)	-1432.3(b) (756.5)	91.2 (60.7)	0.625	690.4	9
1973	10700.5(a) (3047.5)	-1576.4(b) (1068.3)	89.4 (85.8)	0.631	974.9	9

Note: Standard error of estimated coefficients are in parentheses.

a/ Significant at 0.01 level.
b/ Significant at 0.10 level.

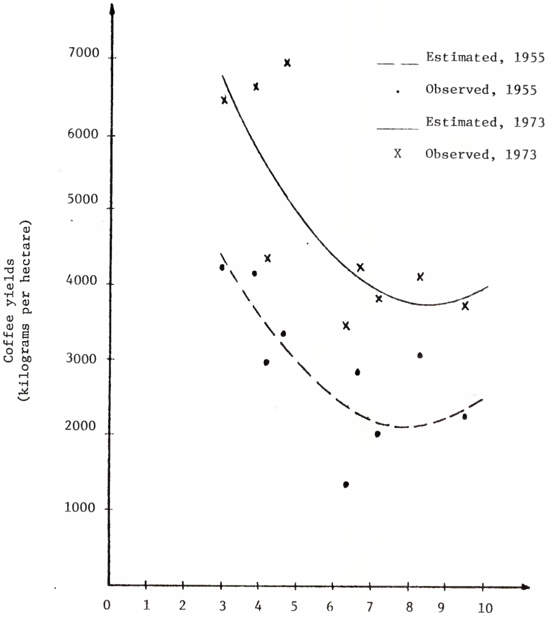

Figure 19. Observed and estimated coffee yields over distance from the center of San José, 1955 and 1973

The yield-distance function conforms to von Thunen theory with intensive cultivation near the market center and declining yields with increased distance from the market. Thus, coffee production, with its stationary nature, has had to trade off land for yields in the face of urban advance.

The increase in coffee yields may be due to several factors: imported varieties, increased capital use (especially fertilizer, insecticides, herbicides, irrigation) or improved cultural practices. As presented in Chapter III, Costa Rican farmers have substituted fertilizer for land with changes in the relative prices of these factors. This same trend is pronounced in the Province of San José. Data in Table 53 demonstrate that between 1955 and 1973 the number of coffee farms using fertilizer increased from 619 to 6,849. This increase in fertilizer use represents an increase in the percentage of coffee farms using land-saving technology from 7.1 to 52.7 percent. In the same period, the area fertilized on coffee farms in the province increased by a factor of 3.5 with 71.1 percent of all coffee lands fertilized in 1973. Rate of fertilizer application increased by 30 percent.

This trend in the growth of fertilizer use appears to have induced a shift from the traditional *Arabica* variety of coffee to the more fertilizer responsive hybrid varieties. Table 54 presents data on area in production, total production and yields for coffee varieties in the San José Province. In 1955 the traditional variety accounted for 83.9 percent of the coffee area in production and 83.1 percent of total coffee production in the province. With less area fertilized and lower rates of fertilizer application, the traditional *Arabica* produced 20.1 percent higher yields than the hybrid coffees, which accounted for 7.5 percent of producing area and only 6.2 percent of total production.

Table 53. Fertilizer use on coffee farms, Province of San José, 1955 and 1973

Item	Units	1955	1973	1955	1973
				--percent--	
Farms using fertilizer	each	619	6,849	7.1	52.7
Area fertilized	hectares	5,052	17,438	26.3	71.1
Fertilizer rate	kilograms/ha.	424	551	-	-

Source: Costa Rican Agricultural Census, 1955 and 1973

Table 54. Area, total production and yields for coffee, by varieties, Province of San José, 1955, 1963 and 1973

Item	Units	1955	1963	1973
All varieties				
Area in production	hectares	15,483	22,371	24,510
Total production	metric tons	14,336	25,662	47,011
Yield	kilograms/ha.	1,852	2,294	3,836
Traditional (Arábigo)				
Area in production	hectares	12,993	15,892	(a)
Total production	metric tons	11,909	17,412	(a)
Yield	kilograms/ha.	1,833	2,191	(a)
High-yielding (Hibrído)				
Area in production	hectares	1,167	4,791	(a)
Total production	metric tons	890	6,351	(a)
Yield	kilograms/ha.	1,526	2,651	(a)
Other varieties (Otras)				
Area in production	hectares	1,323	1,688	(a)
Total production	metric tons	1,537	1,899	(a)
Yield	kilograms/ha.	2,324	2,250	(a)

a/ Data not available.

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Eight years later, the area in hybrid varieties increased by a factor of 4.0 representing over a fifth of producing area; total hybrid coffee production increased by a factor of 7.1 representing a quarter of total production; and the new, improved coffees produced 21 percent higher yields than the less fertilizer responsive traditional variety. Although data on varietal use are not available for 1973, one may deduce from the substantial increase in coffee yields during the 1963-1973 decade (67.2 percent) and the continued increase in fertilizer use that this trend towards more fertilizer-responsive varieties has continued.

Annual crops, typified by corn production, reflect a pattern similar to permanent crops in response to encroachment by the city, with differences accounted for by the nature of the crops and their consumption characteristics. The number of farms producing corn and the total and per farm area cultivated in corn have declined steadily in the Metropolitan Area. These trends, as reflected in Table 55, have occurred in spite of rising corn prices that have more than doubled in constant colones in two decades. These price increases may reflect increased demand for feed induced by higher prices for animal products. The share of corn production sold has increased from 13.2 percent in 1955 to 61.6 percent in 1973. This though may also reflect the shift towards specialized commercialization of foods and animal feeds. Rural inhabitants have a comparative predilection for corn products. They consume 2.7 times more than the average annual amount of corn consumed by urban residents (see Table 17). Thus, when corn yield data for the principal producing areas within cantons in the Metropolitan Area are plotted over distance from the center city (Table 56) they reveal that

Table 55. Corn production and value for both crops, San José Metropolitan Area, 1955, 1963 and 1973

Item	Unit	1955[a]	1963	1973[b]
No. of farms	Units > 1 mz.	801	668	440
Area cropped	Hectare	871[c]	645[c]	337
Total production	Quintal	15,432[d]	15,529[d]	8,271[e]
Area cropped/farm	Hectare	1.087	0.966	0.766
Production/ha.	Quintal	17.7	24.1	24.5
Production/farm	Quintal	19.3	23.2	18.8
Consumed, feed and seed	Quintal	13,397	14,277	3,180[f]
Quantity sold	Quintal	2,035	1,252	5,091
Average price	Current ₡/q.	19.25	37.04	60.45[h]
Price index	1962 = 100	90.8 [g]	103.0	117.5
Value of production	Current ₡ 1,000	297.1	575.2	500.0
Value of production	Constant ₡ 1,000	327.2	558.4	425.5
Sale value	Current ₡ 1,000	39.2	46.4	307.8
Sale value	Constant ₡ 1,000	43.1	45.0	261.9
Share sold	Percent	13.2	8.1	61.6

a/ Includes both monoculture and intercropping.
b/ Computations were made only from selected farms with land area equal to or greater than 0.69 hectares = 1 manzana.
c/ Original data in manzanas (mz.); 1.43 mz = 1.0 ha.
d/ Original data in fanegas of shelled corn = 7.68 quintal(es).One quintal (q.) = 100 lbs. = 46 kilos.
e/ Original data in kilograms of shelled corn.
f/ Deduced, $Q_s = Q_t - Q_c$
g/ 1957 price index used as an approximation of 1955.
h/ Extrapolated with change of basis year from 1962 to 1966.

Sources: Costa Rican Agricultural Census, 1955 and 1963: computer tape of the 1973 Costa Rican Agricultural Census, LADB; MAG-OFIPLAN, 1965; MAG, 1975; unpublished data, BCCR and LADB

Table 56. Corn yields, cantons of amplified San José Metropolitan Area in order of increasing distance from pricipal production areas and the center city, 1955 and 1973

Canton	1955	1973
	---kilograms/ha.----	
Tibás	363	735
Central	726	1,009
Goicoechea	856	1,454
Alajuelita	659	1,144
Moravia	742	1,772
Escazú	644	976
Desamparados	638	1,137

Source: Costa Rican Agricultural Census, 1955 and 1973 the true market for corn may be on the outskirts of the city where animal and poultry production and rural inhabitants are located. The increase in yields and the movement of peak productivity outward also reflects the more fluid response of annual crops, as opposed to permanent plantations, to urban border expansion.

Although annual crops are particularly susceptible to yearly variations in yields, the differences in corn yields between 1955 and 1973 are statistically significant at the 0.005 level of confidence using a one-tailed, paired difference test for small samples. The results of regression analysis for corn yields on distance from the center of San José are presented in Table 57. The regression equations used were of the same form as in equations 5.1 and 5.2. The results prove to be statistically inferior to those of coffee yields. Observed and predicted values of corn yields are plotted in Figure 20.

An analysis of data in Table 58 concerning the density of cattle per hectare of pasture in the cantons of the Metropolitan Area reveals no statistical differences from 1955 to 1973. The main sectors of dairy operations which typify cattle production in the Central Plateau are located in Alajuela to the west and Cartago to the east of San José. Costa Rica possesses one of the most modern dairy industries in Central America, which has been bolstered by the introduction of improved stock -- primarily Jersey, Guernsey and Holstein -- and government sponsored artificial insemination programs [Blutstein, 1970, p. 241]. In the Metropolitan Area dairy production is typified by small operations on fertilized plots of cut pasture.

An indication of the increase in fertilizer usage is provided in Table 59. The percentage of farms in the Metropolitan Area using

Table 57. Regressions of corn yields in kilograms per hectare on distance from center of San José in kilometers, 1955 and 1973

Year	Coefficients of			Coefficient of determination (R^2)	Standard error of estimate	Sample size
	α	β_1	β_2			
1955	54.2 (29.2)	148.7(a) (73.1)	-7.9 (4.3)	0.526	128.3	7
1973	19.0 (78.3)	271.0 (195.8)	-14.0 (11.4)	0.356	343.3	7

Note: Standard error of estimated coefficients are in parentheses.

a/ Significant at 0.10 level.

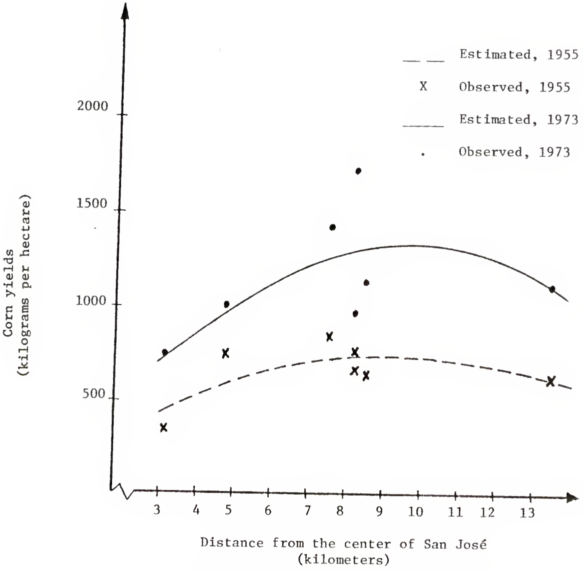

Figure 20. Observed and estimated corn yields over distance from the center of San José, 1955 and 1973

Table 58. Cattle per hectare of pasture, cantons of the amplified San José Metropolitan Area in order of increasing distance from principal production areas and the center city, 1955, 1963 and 1973

Canton	1955	1963	1973
	--------head per hectare--------		
Central	1.62	1.68	1.11
Tibás	1.52	1.60	3.38
Montes de Oca	3.63	3.06	2.26
Curridabat	1.72	2.02	1.69
Alajuelita	2.22	1.23	1.79
Moravia	1.96	1.85	2.79
Escazú	1.35	1.38	1.76
Goicoechea	1.56	1.31	0.80
Desamparados	1.19	1.22	1.20

Sources: Costa Rican Agricultural Census, 1955, 1963 and 1973

Table 59. Percentage of farms using fertilizers, selected areas, Costa Rica, 1955 and 1963

Area	1955	1963
	---percent--	
Costa Rica	12.5	17.4
San José Metropolitan Area	25.4	34.6
Cantons in Metropolitan Area:		
Central	42.3	40.0
Tibás	58.7	46.5
Montes de Oca	38.4	48.9
Curridabat	35.2	57.7
Alajuelita	7.5	30.1
Moravia	35.2	32.5
Escazú	15.7	21.4
Goicoechea	48.1	34.3
Desamparados	14.5	34.1

Sources: Costa Rican Agricultural Census, 1955 and 1963 fertilizers increased by over a third from 25.4 to 34.6 percent from 1955 to 1963. These proportions were twice the frequency of use in the country as a whole. Coffee producers were fertilizing at a rate of 636.5 kilograms per hectare (679 lbs./acre), application for corn averaged 172.4 kg./ha. (154 lbs./acre) and pastures received an average of 188 kilograms per hectare (168 lbs./acre) in 1973 (see Table 25). Thus farmers in the study region with some of the richest soils in the nation are substituting fertilizers for diminished land supplies.

Another case of factor substitution involves the labor component in the productive process. Table 60 reveals the rapid decline of the percentage of the work force (Economically Active Population -- PEA) engaged in agricultural activities in the San José Metropolitan Area. In absolute numbers, this was a reduction from 32, 153 persons in 1963 to 14,928 persons employed in the primary sector in 1973. The effect has been a three-quarters decrease in the labor to agricultural land ratio from 1.08 in 1963 to 0.62 agricultural laborers per hectare in 1973.

This reduction in labor-land intensity has occurred simultaneously with a trend towards mechanization. Farms in the Metropolitan Area employing machinery increased from 4.0 to 17.7 percent from 1955 to 1963, while farms employing human labor exclusively declined from 83.9 to 67.4 percent. The number of tractors increased from 20 to 51 from 1955 to 1973 while total agricultural land diminished. The result has been a decrease in the average acreage per tractor from 3,200 to 1,173 in two decades. A similar reduction in land-equipment ratios is registered for planters, which now are proportioned among 160 hectares of annual cropland, a third less than the 473 hectare average in 1955.

Table 60. Percentage of the Economically Active Population (PEA) engaged in agriculture, San José Metropolitan Area, 1963 to 1973

Canton	1963	1973	Change 1963-1973
	---------------percent---------------		
Central	3.71	1.39	-48.8
Tibás	6.08	2.24	-38.9
Montes de Oca	7.65	3.10	-35.5
Curridabat	22.96	7.37	-41.8
Alajuelita	16.03	4.68	- 8.7
Moravia	9.91	2.86	-46.4
Escazú	32.83	12.60	-27.2
Goicoechea	6.62	2.64	-39.0
Desamparados	14.42	3.44	-26.8
San José Metropolitan Area	7.36	3.06	-32.9

Source: INVU, 1976

CHAPTER VI
SUMMARY AND CONCLUSIONS

Introduction

Costa Rica and particularly the Metropolitan Area of San José, the nation's primate city and capital, were selected for a study of the relationship between agriculture and urbanization. Urbanization and agricultural development are both complementary and competitive processes. First, the study considered man's use of land in historical terms and then the focus was shifted to the use of the traditionally most productive soils of the country, located around the rapidly expanding urban center of San José, during the period from 1950 to 1973.

In the agricultural sector, quantity of output may expand by merely bringing more land under cultivation without changing production techniques or inputs other than traditional inputs and labor. Alternatively, modern capital inputs and production techniques may be used to increase the productivity of land and labor.

As rural economies become more productive, agricultural surpluses may be used to: furnish food for urban-industrial residents; provide exportable commodities, which in turn may be traded for imported goods and services; and provide inputs for industrial and manufacturing processes that are usually urban-oriented activities. Urban-produced goods provide items for consumption and inputs for the use in production to the agricultural sector. Also, urban services can provide specialized functions: expand and improve the market; create demands for accelerated economic growth; furnish economic and political stability and protection; and establish conditions conducive to more modern development.

Complementarity between urban and rural sectors becomes competitive at the margins of urban centers. Urban expansion tends to be at the expense of fertile agricultural lands that originally attracted settlers to the area. The conversion of rural to urban land places a double pressure on agricultural land. Growing urban populations tend to develop higher standards of food consumption, reinforced by greater effective demand. Yet commodities must be produced on increasingly more inelastic and at times diminishing supplies of productive land. The response of rural producers was to increase yields to compensate for higher economic rent pressures, due to competition from urban uses. The particular manner in which capital and technology was substituted for traditional land and labor inputs and the resulting configuration of land use was analyzed in this study.

Theoretical Considerations

Several assumptions and theoretical concepts are useful in understanding the changes in the productive use of agricultural land under pressure of urbanization. Land values depend upon supply and demand characteristics. For agricultural land, demand is based primarily on its inherent fertility and productivity, and location is of lesser importance; for urban land, the reverse is true.

Agricultural producers tend to locate first on lands with the highest fertility and productivity. This fact reflects their rational economic objectives of maximizing net revenues and minimizing costs with respect to output. The margin of production extends to where profits are equal to zero. According to the Ricardian concept, production will expand into areas of lower quality land as demands increase and time passes. Rents and land values will increase inside the margin.

According to von Thunen's concept, as a market center forms, transport costs affect land rents, values and use. Marginal net revenue per unit of product, net rents and land values decline with distance from the market. Thus, the intensity of use of capital inputs increases as product demand and food prices increase and decrease with distance from the market center. The manner in which capital is substituted for land and labor is a function of changes in technology and in relative prices of inputs.

Growth and Development

The colonization of the Central Plateau of Costa Rica by Europeans follows Ricardian tenants. The most fertile land with abundant water was first. The circular settlement pattern of the Indians, located on terraces between the valley floor and the surrounding mountain ranges, was displaced by Spanish colonizers. Highways converged towards the center of a previously uninhabitated island of fertile soil which had once separated the villages. Efforts by ecclesiastical and military authorities coerced the foundations of small urban centers. The foundation in 1781 of a tobacco inspection and taxation station at San José created an incipient radial market center and transportation focal point.

Coffee

The introduction of coffee culture induced not only a period of expansion into unoccupied lands, but contributed as well to fundamental economic, political and social developments. The expansion of coffee production was fostered by governmental policies which offered public domain lands for homesteading. Urban trading companies developed to commercialize the exportation of coffee, the importation of consumer goods, and the administration of credit from British merchants. Traders soon acquired political power and wealth that dominated the nation's social structure for the next century. Capital-intensive technologies employed by this group for processing coffee, coupled with wide-spread mortgage default among growers, soon differentiated the once homogeneous nation of small land owners into laboring and larger land-holding classes.

The resultant spread of coffee plantations, initially around San José and later around the urban centers of Alajuela and Heredia, corresponds to von Thunen land use postulates, transfigured by differences in geographic features. Production ringed the urban market centers. Coffee land rents outbid those for tobacco, wheat and other crops previously cultivated for internal consumption. The reduction of export transportation costs with the development of railroads to the Atlantic and Pacific coasts expanded the economically productive margin. Prosperity and population growth resulted in migratory flows which extended into lands of lower soil quality. The solution to economic stress caused by fluctuating prices for exports released population pressures into uninhabited regions.

Closure of the Frontier

The era during which production could be augmented through the expansion of farm land, and social tensions could be released to the frontier appears to have ended in Costa Rica. The implication of the closure of the agricultural frontier as a means of expanding production for Costa Rica, given a strong trend of population increase, is to develop means for increasing yields per unit of area in order to maintain, and possibly increase, per capita income and consumption. The addition of new and improved capital inputs to land is the means of increasing production yields from land.

An analysis of data from agricultural censuses shows that the compound rate of growth in farm land dropped from an average annual rate of 5.5 percent during 1955-1963 to an average of 1.7 percent in the following decade. During the period 1963-1973, forests and cultivated cropland diminished, lands in permanent crops increased at a low compound growth rate of 0.3 percent per year, and pastures registered the only substantial increase with an average annual compound growth rate of 6.65 percent, a response to strong international and internal demands for beef. The percentage of the nation's total land surface in farm area increased from 36.4 to 61.3 percent from 1955 to 1973. Estimates of total land in improved uses and active reserves show an increase from 57.7 to 84.7 percent of the total national territory in the same period. Consideration of land quality reveals that only the most marginal lands are presently available for expansion, most of which would require heavy investment for drainage and access. If current trends in population growth and agricultural land expansion continue, yields will have to be 50 percent greater than 1955 levels in the next decade, in order to sustain per capita consumption at present levels.

Migration and Urbanization

Urbanization, the relatively higher rate of population growth in urban zones than in the rest of the country, is a recent phenomenon in Costa Rica. Prior to 1950, as population increased, the primary flows of migrants were from rural areas in the Central Plateau to periferal colonization areas. The result of these migrations was a steady decline in the proportion of the total population in the Central Plateau. With the closure of the agricultural frontier, migratory flows reversed. An accelerating urbanization trend occurred in the country's central region and in the San José Metropolitan Area, where 56.8 and 25.5 percent, respectively, of the total population resided in 1973.

In 1963 the predominantly urban cantons registered a net inmigration of 11 percent, while moderately urban and rural cantons experienced net losses in population at rates of -0.05 and -0.06 percent, respectively [Carvajal and Geithman, 1974, pp. 106-107]. During the following decade, as the nation's total population grew at an average geometric rate of 3.37 percent annually, the urban sector was expanding at more than double the average annual rate of geometric growth for rural populations, 5.01 and 2.39 percent, respectively.

Employment, Income and Gross Domestic Product

As cityward migrations, stimulated by substantial urban-rural wage differentials, and high rates of population growth contributed to urbanization, fundamental changes occurred in the economic structure of the economy. Trends in employment and economic activity show a shift to urban-oriented secondary and tertiary sectors of the nation with concurrent increases in the Gross Domestic Product (GDP), per capita income, and productivity.

Salary differentials have been shown to be a significant factor in the determination of rural to urban migration [Carvajal and Geithman, 1974, pp. 108-109]. Incomes for urban-oriented occupations--industry, construction, commerce, transportation and services--range from a half to three times as great as the average monthly salaries of ₡ 395 ($46) for agricultural labor. This economic inducement to migration coincided with a reduction of the proportion of the total labor force in the primary sector from 54.7 to 36.4 percent and a decline of agriculture's share in the Gross Domestic Product from 38.3 to 18.8 percent from 1950 to 1973. During the same time period, GDP increased from $188.3 to $867.8 million (in 1962 prices) at an average annual compound rate of 6.92 percent. Estimates of per capita real income more than doubled, from $283 to $595 yearly, in 1962 prices.

Exports

Agricultural products have traditionally supplied Costa Rica not only with a large proportion of its national income, but also with foreign exchange earnings through exportation. In 1950, coffee, bananas and cocoa accounted for 98.0 percent of total export earnings of $54.1 million. By 1973, although the value of agricultural exports had increased five-fold to $257.5 million, these three products' share of total exports had dropped to 54.9 percent. Industrially produced goods, primarily processed agricultural commodities and surpluses from national fertilizer and insecticide production, accounted for over a quarter of the value of export trade. This trade in industrial products was primarily with members of the Central American Common Market (CACM). Diversification efforts and strong international price inducements caused a five-fold increase in sugar and beef exports during 1963 to 1973, when these products surpassed cocoa as the third most valuable export.

Domestic Consumption

Increases in per capita income and in the percentage of urban population have coincided with changes in food consumption. Although time-series and cross-sectional consumption data are limited, it appears that Costa Ricans, on the average, are increasing the percentage of income spent for food and substituting protein for carbohydrate products. These characteristics are typical of the early stages of developing economies.

Family expenditures for food products increased from 44.7 to 45.2 percent of total income from 1949 to 1961 [DGEC, 1965, pp. 12-16]. Average protein consumption increased from 27 to 35 percent, while carbohydrate consumption decreased from 72 to 63 percent of dietary consumption from 1950 to 1963 [OFIPLAN, 1965, pp. 33-37]. Cross sectional data for 1971 reveal that urban inhabitants with average monthly income of $199 consume, on the average, twice as many pounds of meat products, three-quarters the amount of basic grains (corn, rice and beans) and significantly greater quantities of animal products (milk and eggs) as rural inhabitants, whose incomes averaged $93 per month [Cespedes, 1973, p. 69]. Income-consumption analyses of these data reveal that income elasticity coefficients and marginal propensities to consume for basic grains are low or negative, animal products have middle-range values, and meat products have relatively high values.

Agricultural Production

As increases in population and per capita income expanded food demand, food prices rose. Increases in domestic and export demands induced increases in the production of agricultural products. With inelastic supplies of agricultural land and labor, productivity of these traditional production factors increased.

Indexes of total agricultural and food production increased at average annual compound rates of 4.5 and 4.9 respectively, from 1950 to 1973. During this period, agricultural land and labor increased at average annual compound rates of 2.3 and 1.6 percent, respectively. The results of differential rates of growth in agricultural production and in traditional agricultural production inputs were accounted for by increases in the productivity of land and labor. Yield increases tended to be greater among export crops than among crops for the domestic market.

Modern Inputs and Induced Innovation

The use of modern land- and labor-saving production inputs from the industrial sector contributed to increases in agricultural production and productivity and eased the constraints of inelastic supplies of land and labor. Use of modern production inputs increased significantly from 1950 to 1973 due, in part, to changes in relative input prices. This trend induced innovation in production technology.

While agricultural land and labor expanded at relatively low rates from 1950 to 1973, fertilizer and mechanized horsepower use increased at average annual compound rates of 18.7 and 13.9 percent, respectively.

Agricultural wages and average land values in constant prices increased at an average compound rate of 4.3 percent per year. Meanwhile, fertilizer prices in constant terms decreased at an average annual compound rate of 4.4 percent and the machinery price index remained relatively constant. Regression analysis indicated that changes in the ratios of modern and traditional production inputs used are explained in terms of changes in factor price ratios.

Urbanization and Urban Growth

Latin America has some of the highest rates of population growth and urbanization in the world. For Costa Rica, these trends are pronounced in the San José Metropolitan Area (SJMA). This city plays a dominant role in the nation's economic activity--industry, commerce, transport, communication and government--serving as a focus of the exchange of goods, ideas and innovations.

Population

More than a quarter of the nation's total population and over half of its total urban population resided in the SJMA in 1973. From 1950 to 1973, population grew at an average annual compound rate of 4.3 percent in the SJMA compared with a 3.5 percent rate in the rest of the country. Migration to this area--influenced by the closure of the agricultural frontier, changing modes of production, urban-rural wage differentials and the attraction of urban services--has been a major contributor to rapid urbanization. Between 1950 and 1963, a quarter of the increase in population in the SJMA was due to migration; five years prior to 1973, over a fifth of the population had lived in other areas.

Urban Area

Analysis of population data showed high population density at the center of the SJMA which declined in a negative exponential manner over distance from the center city. Time-series analysis indicated that this spatial population density distribution increased and spread out as growth "waves" of inhabitants emanated from the urban center. Urban areas expanded at an average annual compound rate of 4.4 percent from 1955 to 1973, displacing an average of 122 has. of rural land per year. If this trend of urban expansion continues at current rates, the entire area suitable for construction in the SJMA will be urbanized by 1990. Land use analysis shows that the city expands in concentric government-business-residential patterns which displace agricultural land as urban land values greatly exceed rural land values.

Agriculture Under Urban Pressure

As urbanization intensified in the Central Plateau and especially in the SJMA, there were increased pressures on agricultural land for additional space and production. The result was a reduction in the number and area of farms, changes in institutional arrangements and increases in yields. In some cases, this response exhibited a definite spatial pattern.

Farms and Area

From 1950 to 1973, the number of farms and the area in farm lands declined by 54.8 and 47.1 percent, respectively, for the six cantons entirely within the SJMA. This change was due to the competitive opportunity cost for urban land uses, primarily residential, with higher land values. Analysis of average farm size showed that larger farms were sold for urban development. Declines in land use were registered for forests, annual and permanent crops; only pastures and the "other" category increased in area during this period. Case studies of aerial photographs and other evidence indicated that the major factors in this differential decline and expansion of agricultural land were urban proximity, especially areas near the urban fringe and transportation arteries, and the demand characteristics of urban food consumption. While most farms were owner-operated in the SJMA, there was a definite trend towards larger, corporate and cooperative type farm units as urbanization increased.

Production Response

With reduced land supplies and increased food demand, farmers in the SJMA tended to increase yields. Although yields typically vary greatly from year to year, trends for coffee indicated substantial yield increases. Higher yields were found closer to the urban center and declined with distance from the city. Increases were due to substantial increases in fertilizer use, shifts to more fertilizer responsive varieties and increased mechanization. Annual crops, typified by corn production, showed a similar yield-distance response, whereas no statistically significant changes were noted for cattle production. In general, increased fertilizer and mechanization reduced the constraints of inelastic land and labor supplies under urbanization pressures.

Policy Recommendations and Further Research

General Economic and Spatial Recommendations

In this thesis, differences in relative price ratios, operating through the price mechanism, acted as effective inducements for factor substitution and technological innovation in agricultural production. The specific cases considered, land- and labor-saving innovations, operated unidirectionally as the prices of land and labor increased in relation to prices of fertilizer, machinery and power during the years 1950 to 1973.

Since 1973, rapid inflation of energy prices has occurred. Given the predicted continuance in this trend of relatively expensive energy, the following recommendations are presented to foster economic growth in Costa Rica:

(a) Investigate policies conducive to a shift of the geographical location of economic activity and a decentralization of administrative functions from the Central Valley to an east-west axis passing through San José.

(b) Develop hydroelectric power and control water resources for irrigation and flood protection along this axis. The easing of hydrological and energy constraints would allow expansion of all sectors along the coastal plains.

Sectorial Recommendations

The expansion of the Costa Rican economy through emphasis on the long-range development of domestic energy and water supplies, and the decentralization of economic and political activity along a central east-west axis would have secondary effects on all the economic sectors.

Agriculture. New market concentrations of industrial workers and improved infrastructure, especially transport arteries, along the coastal plains would initially foster agricultural development in the northwest and expansion into the northeast regions of Costa Rica. Urban pressures on the rich agricultural lands of the Central Valley would be somewhat relieved.

Research efforts could be aimed at:

(a) Efficient management and use of water storage to counteract seasonal hydrologic fluctuations.

(b) Experimentation with more labor-intensive cropping systems for the frontier region and more land-intensive systems in the densely settled Central Valley region.

(c) Diversification of cattle enterprises in the Nicoya Peninsula to reduce risks of international market fluctuations and increase the efficiency of protein production vegetatively.

(d) Promote research, development and a higher degree of commercialization and market access of agricultural commodities for domestic consumption, especially basic grains, in order to reduce urban cost of living while increasing rural incomes and employment.

Industry. The location of industry in port cities and along the coastal plain transportation routes could provide large savings in the costs of transporting goods and energy transmission, as well as more productive utilization of lower quality lands. This is particularly applicable for assembly manufacturing of trans-American goods and the processing of domestic agricultural products.

Transportation. Long-range goals would be the construction of primary transport arteries linking Nicaragua and Panama to the central east-west Costa Rican rail and highway axis. The juncture of the two railroad systems into a single linkage would improve efficiency. The development of secondary access roads would foster agricultural expansion. Trade within the Central American Common Market would be expected to increase with a reduction in transport costs.

Construction. Increased demands upon the construction industry in the low land region may require financial credit made available through national and international agencies. The development of forest reserves in the northeast could provide initial building materials.

Government. Differential taxation of urban and rural land uses through established agencies, forced savings through payroll deductions and external loans could provide some of the capital requirements of these recommendations. Preferential tax rates on agricultural lands would have a secondary effect of reducing urban growth in the dense Central Valley and fostering expansion in low land regions.

GLOSSARY

Term	Translation or equivalency
Acre (ac.)	0.4047 hectares = 0.699 *manzanas*
Arroba	11.5 kilograms = 25.0 pounds
Bananas	1 stem or *racimo* = 50 pounds
Botella	1 bottle = 0.67 liters
Caballería	13.6 hectares = 33.5 acres
Cajuela	1 box = 4 *cuartillos* ≈ 7 pounds
Casas comerciales	commercial trading companies
Código fiscal	fiscal code
Coffee	in cherries: 1 metric ton = 20.9 *fanegas* in beans: 1 *quintal* = 100 pounds
Colón (₡)	8.54 *colones* = US$ 1.00; 1 *colón* = 100 *céntimos*
Conquistidor	Spanish conquerer
Encomienda	granted estate
Factoría	inspection and taxation building
Fanega (fan.)	24 *cajuelas* = 353.28 k. (corn, shelled) = 181.44 k. (coffee, beans)
Gallo pinto	beans and rice dish
Hacienda	landed estate, plantation
Hectare (ha.)	2.471 acres = 1.431 *manzanas*
Horsepower (HP)	1.014 HP (metric) = 33,000 foot-pounds/minute

Glossary - continued.

Term	Translation or equivalency
Hundredweight	100 pounds = 1 quintal = 46 kilograms
Kilogram (kg.)	1,000 grams = 2.205 pounds
Kilometer (km.)	1,000 meters = 0.6214 miles
Latifundia	large farming estates
League	approximately 3 miles = 7.4 kilometers
Liter (l.)	1.507 quarts = 1.492 botellas
Manzana (mz.)	0.699 hectares = 1.727 acres
Metric ton (m. ton)	1,000 kilograms = 2,205 pounds
Minifundia	small farming parcels
Parásito	squatter
Pounds (lbs.)	453.5 grams = 16 ounces
Quintal (q.)	100 pounds = 46 kilograms
Reducción	settlement of converted Indians
Repartimiento	division of Indians for taxation
Tierras baldías	public domain land
Vara	0.836 meters = 32.913 inches

APPENDIX I. Census tract, San José Metropolitan Area, 1973

Census tract enumeration	Total census tracts
	------number-------
0001 - 0697	697
0717 - 0749	33
0771 - 0787	17
0961 - 1100	140
1134 - 1147	14
1158 - 1180	23
1257 - 1360	104
1370 - 1463	94
1502 - 1532	31
Total	1,153

	Population 1950	1963	1973
I. Official	180,228	323,563	478,018
II. Amplified	190,332	341,119	503,733
III. % (II/I)	94.7%	94.9%	94.9%

APPENDIX I - continued.

Province	Census tracts
	---number----
San José	1,728
Alajuela	798
Cartago	429
Heredia	296
Guanacaste	532
Puntarenas	570
Limón	340
Total	4,693

Comparative land areas of the "amplified" and "official" San José Metropolitan Area, 1973

Canton	"Amplified"	"Official"
	--hectares-	-hectares-
Central	4,491	4,491
Escazú	3,531	3,531
Desamparados	12,625	1,854
Goicoechea	13,083	1,908
Alajuelita	2,154	974
Tibás	849	849
Moravia	2,937	547
Montes de Oca	1,532	1,532
Curridabat	1,634	1,634
Total	42,836	17,321

Sources: Unvalidated data from "Plan Nacional de Desarrollo Urbano" (PNDU); Office of Metropolitan Area Planning (INVU)

Appendix II. Population, Gross Domestic Product and indexes of agricultural and food production, 1950-1973

Year	Total population ---1,000--	Gross Domestic Product	GDP agricultural sector	Total agricultural index	Total food index
		------₡ 1,000,000------		--1951 - 53 = 100---	
	CR1	CR2	CR3	CR4	CR5
1950	800.9	1,304.9	538.5	78	87
1951	832.4	1,500.4	601.2	84	89
1952	865.2	1,700.5	714.3	100	113
1953	899.3	1,810.1	708.0	97	97
1954	934.7	2,011.3	799.8	109	108
1955	971.5	2,071.4	731.9	96	92
1956	1,009.7	2,151.0	739.9	98	95
1957	1,049.5	2,500.0	754.4	102	118
1958	1,090.8	2,609.0	737.2	115	129
1959	1,133.8	2,678.5	698.6	119	131
1960	1,178.4	2,860.5	744.7	134	156
1961	1,224.8	2,929.3	754.2	132	158
1962	1,273.1	3,186.6	823.0	133	156
1963	1,336.3	3,404.2	832.8	127	161
1964	1,381.3	3,608.2	886.4	118	141
1965	1,427.9	3,928.5	924.0	135	164
1966	1,476.0	4,288.4	994.1	149	185
1967	1,525.7	4,633.9	1,065.6	160	198
1968	1,577.1	5,126.7	1,178.4	161	199
1969	1,630.3	5,655.3	1,302.9	175	217
1970	1,685.2	6,524.5	1,469.3	188	232
1971	1,742.0	7,137.0	1,443.4	190	229
1972	1,800.7	8,215.8	1,601.6	200	241
1973	1,871.8	9,988.8	2,003.9	218	268

APPENDIX II - continued. Agricultural land, labor, fertilizer and power inputs, 1950-1973

Year	Agricultural land	Agricultural labor	Quantity of fertilizer	Power inputs
	--1,000 ha.--	---1,000----	-1,000 m.tons-	-1,000 HP-
	CR6	CR7	CR8	CR9
1950	1,811.2	148.8	8.5	9.4
1951	1,819.4	151.7	6.0	10.8
1952	1,827.4	156.6	8.2	12.4
1953	1,835.6	158.6	14.5	14.3
1954	1,843.7	162.2	27.8	16.4
1955	1,851.9	165.2	24.2	15.8
1956	1,937.3	168.3	29.9	21.7
1957	2,030.0	171.5	44.6	24.8
1958	2,123.1	175.7	45.5	28.6
1959	2,224.9	179.8	54.3	32.9
1960	2,326.7	182.5	57.8	37.8
1961	2,438.0	187.8	52.5	43.5
1962	2,549.1	190.6	62.1	50.0
1963	2,668.1	194.2	64.8	57.5
1964	2,710.6	196.4	100.0	65.5
1965	2,753.2	198.7	200.0	75.4
1966	2,796.9	200.7	245.0	68.7
1967	2,841.5	201.6	288.0	99.7
1968	2,886.2	203.5	306.0	114.7
1969	2,932.5	205.4	478.0	131.9
1970	2,971.0	207.3	541.8	150.2
1971	3,043.3	209.2	493.6	172.8
1972	3,095.7	211.2	572.7	198.8
1973	3,122.5	213.1	629.0	228.7

APPENDIX II - continued. Indexes of average land values, agricultural wage rates, fertilizer and machinery prices, 1950-1973

Year	Average land value index	Agricultural wage rate index	Fertilizer price index	Machinery price index
	----------------------------1952 = 100	------------------------		
	CR10	CR11	CR12	CR13
1950	91	91	105	
1951	97	96	102	
1952	100	100	100	
1953	103	104	100	
1954	112	109	100	
1955	124	114	90	
1956	130	119	92	119
1957	137	124	83	130
1958	140	129	83	112
1959	142	135	72	124
1960	145	141	71	130
1961	146	147	68	116
1962	151	154	61	115
1963	156	161	60	125
1964	155	167	55	108
1965	158	175	52	101
1966	163	183	59	118
1967	174	191	50	122
1968	179	199	41	115
1969	186	208	44	120
1970	195	217	41	119
1971	201	226	40	124
1972	219	236	36	127
1973	242	247	38	114

APPENDIX II - continued. Indexes of general and food prices

Year	General price index	Food price index
	-------1952 = 100------	
	CR14	CR15
1950	96	96
1951	103	105
1952	100	100
1953	100	102
1954	103	106
1955	107	110
1956	108	110
1957	110	111
1958	113	116
1959	113	115
1960	114	115
1961	118	115
1962	121	119
1963	125	123
1964	129	130
1965	128	128
1966	128	129
1967	130	130
1968	135	137
1969	138	143
1970	145	154
1971	150	160
1972	157	164
1973	180	195

CR1 *Total population* (1,000). Actual and estimated population figures from census data. Although estimates of total population exist in the *Anuarios* of DGEC, it was found that these data contain a significant bias.

Sources: DGEC, *Población*, 1953, 1966 and 1974b.

CR2-3 *Gross Domestic Product* and *GDP, agricultural sector* (¢ 1,000,000 current). National accounts figures were spliced using estimates from the Dept. of Long- and Medium-Range Plans of OFIPLAN (1950-1965) and data from the Costa Rican Central Bank (1960-1973).

Sources: OFIPLAN, 1967a and 1967b; BCCR, 1960-1973.

CR4-5 *Total agricultural index* and *Total food index* (1951 - 1953 = 100). Both indexes spliced from different series calculated by the Foreign Regional Analysis Division of USDA-ERS. Country indexes are based upon Laspeyre's base-weighted aggregative formulas; base periods of 1957-1959 and 1961-1965 were changed to 1951-1963 using adjustment coefficients for overlapping years.

Sources: U.S. Department of Agriculture, ERS/FRAD, 1962-1966, 1969-1975.

CR6 *Agricultural land* (1,000 ha.). Area in agriculture represents actual and estimated figures from regression analysis of agricultural census data (1950, 1955 1963 and 1973).

Sources: DGEC, *Agropecuario*, 1959, 1965 and 1974a.

CR7 *Agricultural labor* (1,000). Actual and estimated Economically Active Population in the primary sector from population census data.

Sources: DGEC, *Población*, 1953, 1966 and 1974b.

CR8 Quantity of fertilizer (1,000 m. tons). Total fertilizer supply before national production (1950-1963) assumed to be equal to total weight of yearly imports; post-national production data for national use from FAO-UN estimates (1966-1973); and intervening values interpolated from trend (1964-1965).

Sources: DGEC, Anuario, 1951-1952 and Comercio Exterior, 1956-1973; FAO, 1963-1974.

CR9 Power inputs (1,000 HP.). A measure of power inputs constructed by aggregating animal and tractor horsepower from agricultural census data and using regression analysis to estimate intervening values. Animal equivalent was 1HP/each mule, oxen and horse; tractor equivalent was 27 HP/tractor, compounded at 7 percent per 5 year period to compensate for technological innovations. For further discussion of methods used, see Hayami and Ruttan [1971, pp. 334-337].

Sources: DGEC, Agropecuario, 1959, 1965 and 1974a.

CR10 Average land value index (1952 = 100). Derived by dividing total value of real estate from national account estimates (see CR2-3) at market prices in millions of colones by total agricultural land area in hectares (from column CR6), adjusting with the General Price Index (from column CR14), and indexing with 1952 = ₡85.8596/ha.

Sources: OFIPLAN, 1967a; DGEC, Anuarios, 1973.

CR11 *Agricultural wage rate index* (1952 = 100). Average actual and estimated farm wages per day in *colones* for agricultural labor, adjusted with GPI (from column CR14), and indexed with 1952 = ₡3.14/day.

Sources: Correa Cancino, 1956, IICA; DGEC, *Población*, 1966b; Carvajal and Geithman, 1974, unpublished data.

CR12 *Fertilizer price index* (1952 = 100). Prices were standardized to dollar value of 100 kilogram sacks, F.O.B. by dividing total value of fertilizer imports and exports by total weight of imports and exports. These figures were adjusted with GPI (from column CR14) and indexed with 1952 = $10.39/100 k. sack.

Sources: DGEC, *Anuarios*, 1951-1952 and *Comercio Exterior*, 1956-1973.

CR13 *Machinery price index* (1952 = 100). Prices were calculated by dividing average value of imported tractors in *colones* by average weight of imported tractors. These figures were adjusted with GPI (from column CR14) and indexed with 1952 = ₡1.18556/k.

Sources: DGEC, *Comerico Exterior*, 1956-1974.

CR14-15 *General price index* and *Food price index* (1952 = 100). Both indexes are from DGEC survey data conducted in San José. Values (1965-1973) adjusted for a base change with 1964 = 100 by use of coefficients calculated from overlapping years (1965-1967).

Sources: DGEC, *Indices de Precios*, 1952, 1955 and 1957-1973.

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William R. Goodwin was born on December 11, 1945, in Fort Lauderdale, Florida. He graduated from Mt. Vernon High School in Alexandria, Virginia, and obtained his Bachelor of Science degree in Agricultural Economics from the University of Florida in 1972. His interest in the economic development of Latin America was greatly influenced by experiences as a Peace Corps Volunteer in Venezuela (1966-1969) and as a field reseacher in the Dominican Republic (1972) and in Costa Rica (1974-1975).

Mr. Goodwin has worked for the Division of Plant Industry and Consumer Affairs of the Florida Department of Agriculture, taught tropical farm management in the Department of Food and Resource Economics and instructed courses in cultural and political concepts in the Department of Social Sciences at the University of Florida. He has authored chapters and articles in Política Pública de Crecimiento Urbano: La Experiencia de Costa Rica, Internationales Lexicon der wirschaftlichen und sozialen Institutionen, Algunos Aspectos de la Investigación del Area Metropolitana, Annals of Systems Ecology and Costa Rican Profiles, 1963-1973.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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